ILLINOIS BEEF COW HANDBOOK

MANAGEMENT
HEALTH
PASTURES
ECONOMICS

University of Illinois at
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Selection of a prospective herd sire should combine visual appraisal with evaluation of performance records for the individual and the herd. (Fig. 1)

BREEDING, FEEDING, AND MANAGEMENT OF THE BEEF COW HERD

A beef cow herd can provide both pleasure and profit on Illinois farms which are suited to handling cattle. Good management is the key, and this section was prepared to offer suggestions and ideas for successful operation of a beef cow herd. Although some of the management practices will vary from farm to farm and from one end of the state to the other, the profitable beef cow herd must be productive in terms of pounds of calf or yearling sold per cow. Information on growing-finishing programs for feedlot cattle is not included in this circular, but can be obtained from Illinois Extension Circulars 1025 and 1026.

Selecting a Herd Sire

The selection of a herd bull is one of the most important management decisions a herd owner makes. This decision is not something to be done on the spur-of-the-moment, but requires careful thought and planning. Many herd owners fail to realize the value of a good bull.

Before starting out to buy a new herd sire, take some time to evaluate the cow herd and current calf crop. Where do they need the most improvement? Is it in muscling, soundness, size, gaining ability, ruggedness, or some other trait? Once you have determined where your cow herd is weak and have evaluated your herd's performance, then set out to select a bull that should contribute to herd improvement.

Decide which herds you should visit or which sales you should attend. Buy from reputable breeders who are known to be doing a good job of production. Take your time in making a selection. Start well ahead of the time you need a bull, so you will have a better selection of bulls from which to choose (Fig. 1).

Be sure the bull you select meets the following criteria:

1. Large framed with plenty of size for age.
2. Structurally correct (including feet and legs).
3. A good 205-day weight (adjusted for age of dam) and a good 365-day adjusted weight.
4. Good muscling.
5. Calved from a good-producing cow that consistently ranks in the top half of the herd.
6. Sired by a bull that has been doing a good job of settling cows and siring large-framed, fast-gaining calves.
7. Healthy.
8. Normal testicular development; both testicles present, fully descended, sound, and nearly equal in size.

Crossbreeding

A great deal of interest in crossbreeding has developed in recent years. Part of this increased interest is caused by the large number of new breeds that have attracted the attention of U.S. cattlemen. These breeds, mainly European, are new to our country, but are well established in the countries where they originated. Some of these "exotic" breeds have not been here long enough for cattlemen to evaluate their true merit or to determine how well they will cross with our established breeds. Such things as fertility, calving difficulty, milking ability, weaning weights, feedlot gain, feed efficiency, yearling weight, mature size, and carcass desirability will determine the ultimate acceptability of the "exotics" by U.S. cattlemen.

The success of any breeding program depends upon its objectives and the individual merit of the animals involved. Remember that there is a greater difference in performance within breeds than between breeds. No breed of beef cattle is perfect; each has its advantages and disadvantages. There are animals with outstanding performance records in every breed.

Data collected from several large experiments using Angus, Hereford, and Shorthorn cattle indicate that crossbreeding does have advantages. Crossbred calves in these trials were heavier at weaning and had a lower mortality rate from birth to weaning than did straightbred calves. The same studies also showed that crossbred cows wean a higher percent calf crop and heavier calves than straightbred cows. These advantages for the crossbred female were true even when the straightbred cows were raising crossbred calves.

If a commercial cow herd owner decides to follow a crossbreeding program he faces several major decisions. Here are some questions to be answered:

Should I produce two-breed or three-breed cross calves?

Which breeds should I use and in what order of rotation?

Should I raise my own replacements or should I try to buy them?

What are the major strong points and weak points of the breeds I am considering?

What breeds are most readily available in my area?

Should I use artificial insemination?

Should I consider using any of the new exotic breeds?

Should I consider using some dairy breeding in my crossbreeding program?

The size of cow herd will have a definite influence on the type of crossbreeding program to be followed. For example, a herd owner may decide to produce three-breed crossbred calves from a 30-cow herd. This would be relatively easy if he buys crossbred females, breeds them to a bull of a third breed, and keeps no replacements. However, a herd owner who plans to keep his own replacement heifers needs bulls of at least two breeds on hand at the same time. If he plans to start with straightbred females and produce three-breed cross calves, he will eventually have bulls of three breeds on hand at the same time. The latter is feasible with a large cow herd, but is not practical for a 30-cow herd.

Proper use of crossbreeding can improve herd productivity. The simplest crossbreeding system is to save replacements from the herd and rotate sires of two or three breeds. (Fig. 2)

Probably the easiest crossbreeding program for cattlemen who plan to keep their own replacements and start with straightbred females is the two-breed rotational cross. Follow this program by using a bull of breed B on cows of breed A. Then heifers from this cross are bred back to a bull of breed A. The heifers from the latter mating are bred to a bull of breed B, and so on (Fig. 2).

Before starting a crossbreeding program the herd owner must do some long-range planning. He must not only determine the breeds he wants to use and why he plans to use them, but he must also set up a systematic breeding program and establish production goals for the cow herd.

Successful breeders of purebred cattle are very selective about the bulls and cows they use in the breeding herd. The commercial cow herd owner following a crossbreeding program must be just as selective as the purebred breeder if he expects to produce high-quality calves.

Breeding Considerations

Age at First Calving

Heifers are usually bred to calve the first time when they are two years old. They can calve successfully at 24 months with no adverse effect on mature size if they are properly fed and managed. The real keys to breeding heifers at approximately 15 months of age are size and development. In general, heifers should weigh at least 650 pounds when they are bred (750 pounds for heifers of the larger breeds).

It is important to breed heifers so that they calve early in the calving season. Usually there is more time available for assistance then, and research has shown that a heifer will probably calve early every year after that, producing more pounds of calf in her lifetime. Early spring calves seem to be able to take advantage of the good milk supply associated with the lush growth of spring pastures (Fig. 3).

Heifers calving for the first time will generally have more calving difficulty than mature cows and will therefore require closer supervision and more assistance.

Many breeders like to use bulls of small mature size to breed replacement heifers so they will have a small calf. However, this has not always been a successful practice. Even though birth weight is an important consideration in ease of calving, shape of the calf is probably more important. A heifer will probably have less difficulty giving birth to a 65- to 70-pound calf that is long bodied and long-legged than a 55-pound calf that is short and compact.

Season of Calving

The ideal time for calving will vary from farm to farm and from one end of the state to the other. On an individual farm such factors as labor supply, overall farm management program, availability of pasture or other feed, and the availability of buildings or natural shelter will determine the most favorable time for calving. However, there are a few guidelines that should be considered. Generally, calves born during the summer months have four disadvantages as compared with calves born during other times of the year. They often run into the problems of hot weather, poor pasture, flies, and internal parasites.

Whatever calving season you choose, be sure labor is available to observe the cows closely and routinely and to give prompt assistance if needed.

Management of the Herd at Breeding Time

Even though a 100-percent calf crop is hard to obtain, a herd owner should strive to get as close to this figure as possible. Poor management of the herd at breeding time can greatly reduce the calving percentage.

Close observation during the breeding season is essential so that you will know if the bull is serving the cows normally and if a high percentage are being settled on first service. If a high percentage of the cows have not been settled after two heat periods, the bull should be replaced. One of the first things to do in checking out a poor breeder is to have his semen evaluated. If you have made close observations, you may know the answer if semen quality is not the problem.

Do not allow the bull to run with the cow herd for more than 90 days if you want to keep a fairly short calving period and to lessen the chance of heifer calves being bred. You can expect the best conception rate when cows are gaining well on good pasture.

Under normal Illinois pasture breeding conditions mature bulls can run with 25 to 35 cows; two-year-old bulls can run with 15 to 20 cows. Yearling bulls should be used sparingly (preferably on not more than 12 to 15 cows or heifers with pen breeding and less with pasture breeding).

Breeding during very hot weather often results in lowered fertility and poor conception. Because of this it is important that cattle have access to plenty of fresh water, shelter from the sun, and protection from the flies.

Bulls that are very fat or exceptionally thin may become infertile during the breeding season. Cows that are very fat or exceptionally thin may have a low conception rate. Have your cows checked for pregnancy after the breeding season and consider selling cows that are open.

Artificial Insemination

At least six major factors determine the success or failure of an AI program with beef cows:

1. Level of nutrition.
2. Animal health.

Calves born in early spring usually get off to a good start and are large enough to take advantage of the increased milk supply that comes with lush spring pastures. (Fig. 3)

3. Detection of heat.
4. Time of insemination.
5. Quality of semen used.
6. Skill and knowledge of the inseminator.

Many herd owners are now using AI successfully in their herds and the interest seems to be growing. Most of this increased interest results from:

1. Joint ownership of bulls.
2. Liberalized rules by breed associations.
3. Availability of semen from outstanding bulls direct from breeder or through AI organizations.
4. Availability of semen from "exotic" breeds.
5. Greater interest in performance testing and in using superior sires.
6. Desire to make greater use of superior bulls than can be done under natural service.

Evaluation of Herd Performance

Herd improvement should be one of the major objectives of all commercial and purebred cattlemen. A sound breeding, management, and selection program is needed for improvement, and this is where accurate records come into play. Records should be thoroughly evaluated on a routine basis to obtain maximum benefit from them.

Normally, there is wide variation in performance within most herds of cows. Table 1 shows the average 205-day adjusted weights (steer equivalent) of the calves from the top 20 and bottom 20 cows in four herds enrolled in the Illinois Beef Performance Testing Program.

A great deal of variability can also exist in the performance of calves from different sires used in the same herd. In Table 2 actual records from four herds enrolled in performance testing have been used to indicate these sire differences. By multiplying the differences in sire averages by the current price of choice feeder calves you can arrive at the increased value of the calves from the bull with the high sire average.

Even within a sire group there are large differences in post-weaning performance. Table 3 indicates the differences in performance of five bulls all by the same sire and raised together.

All cow herd owners should be actively participating in a beef performance testing program if they are sincerely interested in developing a more productive and profitable cow herd. Production records, if well kept, can be a useful tool to:

1. Help measure herd productivity.
2. Evaluate bull performance.
3. Identify high-producing cows.
4. Help cull out low-producing cows.
5. Indicate differences in gaining ability of calves and yearlings.
6. Provide permanent yearly records.
7. Help select herd replacements.
8. Supplement what can be seen with the naked eye and retained in memory.

Table 1. — Variability in Beef Cow Production (1970)

No. of cows	Herd av. 205-day adj. wt.	Av. 205-day adj. calf wt. for top 20 cows	Av. 205-day adj. calf wt. for bottom 20 cows	Difference
	(lb.)	*(lb.)*	*(lb.)*	*(lb.)*
116	528 C[a]	599	447	152
297	485 C[a]	574	380	194
117	430 C[a]	494	365	129
81	384 NC[a]	443	330	113

[a] C = creep fed; NC = no creep.

Table 2. — Herd Sire Production Differences in Four Illinois Herds Enrolled in the Beef Performance Testing Program

Herd	Herd av. 205-day adj. wt.	Av. 205-day adj. wt. of calves by sire		
		Low sire	High sire	Difference per calf
	(lb.)	*(lb.)*	*(lb.)*	*(lb.)*
1	405 (4)[a]	373	413	40
2	442 (4)[a]	417	477	60
3	495 (7)[a]	464	528	64
4	420 (4)[a]	387	467	80

[a] The number in parentheses represents the number of bulls used in the herd. No crossbreeding was done in these four herds.

Table 3. — Post-Weaning Performance of Five Half Brothers

Bull No.	205-day wt. adj. for age of dam	165-day post-weaning daily gain	365-day weight	365-day wt. ratio[a]
	(lb.)	*(lb.)*	*(lb.)*	*(Percent)*
1	519	2.67	946	95.9
2	544	2.48	941	95.4
3	525	2.73	962	97.6
4	554	2.91	1,020	103.4
5	578	3.03	1,063	107.8

[a] The ratio of the individual's weight to the average weight of the group, with the group average expressed as 100.

The Illinois Beef Performance Testing Program

The Illinois Beef Performance Testing Program was developed to provide cow herd owners with information that will be of value to them in selecting and culling cattle and in improving the production of their cow herds. Major emphasis in the program is given to:

1. Beef cow performance as evidenced by:
   a. Weaning weight of calves.
   b. Evaluation scores of calves at weaning.
2. Post-weaning performance and evaluation of calves.
3. Carcass quality and merit at slaughter.
4. Herd sire performance as measured by 1, 2, and 3 above.

The Illinois Beef Performance Testing Program is conducted in the state by county Extension advisers with the help of state and area livestock specialists. The basic information required from the herd owner is as follows:

1. Calf identification.
2. Dam identification.

One of the most important reasons for having beef cows in the midwest is to use waste roughages that would otherwise be lost. (Fig. 4)

3. Sire identification.
4. Accurate birth date of calf.
5. Age of dam.

Detailed information on the program (including the Illinois Beef Performance Testing Circular) and the necessary work sheets can be obtained at your local county extension office.

Feeding the Beef Herd

Beef cows can make good use of low-quality roughages that might otherwise be lost as feed. The hardiness of the beef cow allows her to take care of herself during much of the year if pastures and crop residues are available for grazing. However, the ability of the manager is important in knowing when and how to supplement the feed that the cow gets on her own. Feeding recommendations can serve only as a guide and must be adjusted for differences in the weather and feed quality, as well as for the condition of the cows (Fig. 4).

Nutrient Requirements

Estimated daily requirements of crude protein, total digestible nutrients (TDN), calcium, and phosphorus for beef cows are listed in Table 4.

Using Crop Residues and Winter Pasture

The dry, pregnant beef cow can make effective use of a variety of roughages, including the residues left in corn, sorghum, soybean, or small grain fields after the grain has been harvested.

Pasture set aside for winter use may provide low-cost feed for the pregnant beef cow. Fall and winter grazing of crop residues must be used whenever possible to keep feed costs to a minimum. Recent midwest research has shown that two acres of cornstalks will carry a pregnant beef cow for 100 to 120 days in an open winter. If grazing is not possible due to weather, fall plowing, or other reasons, a large part of the wintering ration can be made up of harvested crop residues. Forage harvesters, balers, or stackers with flail pickups can be used to collect forage in cornfields after the grain has been harvested with a combine or picker. By operating the machine a few inches above the ground to prevent excessive dirt pickup, a yield of one to three tons of residue per acre is probable, with the moisture content ranging from 20 to 55 percent, depending on the time of harvest. Stacked or baled cornstalks should be at the low end of this moisture range to reduce spoilage. If the material is to be ensiled, the use of a forage harvester equipped with a screen or a recutter-blower at the silo is necessary to chop the material fine enough for proper ensiling. The moisture content should be 55 percent or more if bunker or unsealed upright silos are used for storage.

Equipment is available to collect the husks, cobs, and small amount of grain that come through a regular combine during the grain harvest. A trailer unit pulled behind the combine is used to collect and dump the

Table 4. — Daily Nutrient Requirements of Beef Cows

Body weight	Crude protein	TDN	Calcium	Phosphorus
Dry pregnant mature cows				
(Pounds per day)				
800	.77	6.4	.021	.021
900	.85	7.1	.023	.023
1,000	.87	7.6	.026	.026
1,100	.97	8.4	.026	.026
1,200	1.03	8.8	.026	.026
1,300	1.09	9.3	.028	.028
1,400	1.14	9.9	.031	.031
Cows nursing calves, first 3 to 4 months after calving				
(Pounds per day)				
800	1.78	11.0	.056	.045
900	1.92	11.9	.058	047
1,000	1.99	12.4	.062	.049
1,100	2.14	13.2	062	051
1,200	2.28	14.0	.062	.053

Use of round bales accumulates forage when it is not needed and provides a labor-free method of supplying winter feed for beef cows. (Fig. 5)

material in piles. This dumping unit allows the operator to collect husklage with little increase in labor or operating time. The resulting husklage piles can be left in the field to supplement grazing or they can be picked up with a front-end loader and hauled home for ensiling. The moisture content of this material will usually be between 30 and 40 percent and the yields will be between 1 and 1.5 tons per acre. If the husklage is to be made into silage, recutting and addition of water may be necessary to get good fermentation.

Since grazing of cornfields is widely practiced in the fall and winter, the feeding of baled, piled, or stacked corn residues in the field could permit grazing during most of the winter without supplemental feeding of hay or silage. There is a possibility that some molds may develop in the collected material, but there would usually not be enough mold present to affect the feed intake or health of mature cows.

Cows can also make good use of sorghum and soybean residues for winter grazing. Research at the Dixon Springs Agricultural Center has shown good results from the harvesting, storing, and feeding of sorghum stover silage. The sorghum plant stays green late in the fall and good stover silage has been made without additional water. The yield of stover will vary with the variety of grain sorghum used, and some of the newer hybrids compare favorably with corn in both grain and forage production.

Fescue pastures are commonly used for winter grazing in southern Illinois. A desirable practice for supplemental feeding involves harvesting hay as round bales during the preceding summer and leaving them in the field for the cows to consume as needed in the winter. Good quality hay can be obtained if the fescue is harvested early enough in the spring. This practice preserves forage not needed during the time of rapid growth and allows a labor-free method of supplying it when it is needed. Newer methods of hay harvesting include mechanical stackers and balers that make large round bales. These stacks or bales can be moved to feeding areas as needed (Fig. 5).

Supplemental feeding of protein, hay, or silage may be needed for wintering cows, depending upon the weather and the type of forage grazed. The feeding of five pounds of legume hay daily per cow would supply a large part of her protein and carotene requirements. When cows are grazing cornstalks or other mature forage without additional feed, supplying some protein supplement a couple of months before calving would appear to be a desirable practice.

While the use of a limited amount of good quality legume hay is the simplest way to provide protein to the cow herd, there are several ways to feed a protein supplement to a grazing animal: (1) Protein blocks can be placed in the grazing areas so the cattle have frequent access to them. Intake will vary with the feed supply and the type of block. Feeding blocks can be expensive if the cows eat them too fast. (2) You can scatter protein cubes on the ground periodically (two or three times a week). This offers a practical method of checking the cattle because the cows will be attracted by the sight or sound of a vehicle if they know there will be something there for them to eat. (3) Liquid supplements can be offered free-choice through a "lick" tank (Fig. 6). This is a convenient, satisfactory way to supply protein, energy, and other nutrients as long as the cattle do not consume more than they need. (4) A free-choice mixture of one-third salt and two-thirds soybean meal apparently has worked in a few instances, but this practice has had very limited use. This salt-soybean meal mixture should be used only if a good water supply is available. Research work on a free-choice mixture of biuret, molasses, and minerals has shown promise.

Wheel "lick" tanks are used in grazing areas to provide a liquid protein, mineral, and vitamin supplement for grazing cattle. Over-consumption is apparently not a problem if the cattle have enough forage to eat. (Fig. 6)

Table 5. — Wintering Rations (1,100-Pound Cow)

	Rations				
	1	2	3	4	5
	(Pounds per day)				
Legume-grass hay	18				10
Legume-grass haylage[a]		30			
Corn or grain sorghum silage			35		
Stalklage or husklage				45	
Straw or cobs					10
Supplement[b]			.5	1	

[a] Haylage figured at 55 percent dry matter, corn or grain sorghum silage at 35 percent dry matter, stalklage-husklage at 45 percent dry matter.
[b] Supplement figured at 48 percent crude protein.

Wintering Rations

When grazing is not possible, the rations in Table 5 could be used to meet the daily needs of protein and energy for an 1,100-pound pregnant cow. A combination of legume roughage with lower quality roughages such as stalklage, straw, or corn cobs will meet both the protein and energy requirements without the use of a supplement.

Lactation Rations

The energy requirement of a cow nursing a calf is about 50 percent higher than that of a wintering dry cow. Protein, calcium, and phosphorus requirements are about double for the lactating cow. Since many Illinois herds will be on pasture during much of the lactation period, the only supplemental need would be salt and minerals, unless the pasture is not providing enough quantity or quality of feed to support adequate milk production. The daily rations in Table 6 could be used for drylot feeding of beef cows nursing calves, but these levels should be approached gradually so that nutritional scours will not develop in baby calves.

Creep Feeding

A summary of data from the Illinois Beef Performance Testing Program indicates that creep-fed calves weigh 45 to 50 pounds more at 205 days than calves that are not creep fed. Even though creep-fed calves are heavier and in better condition at weaning time, it may not pay every herd owner to creep feed. Creep feeding is definitely an advantage for those who sell their calves at weaning time, for those who run out of pasture before weaning, and possibly for those who full-feed calves immediately after weaning. However, it will not pay for those who plan to rough the calves through the winter.

Table 6. — Lactation Rations (1,100-Pound Cow)

	Rations				
	1	2	3	4	5
	(Pounds per day)				
Legume-grass hay	30			20	10
Legume-grass haylage[a]		50			
Corn or grain sorghum silage[a]			60		40
Grain				5	
Supplement[b]			1.5		

[a] Haylage figured at 55 percent dry matter; corn or grain sorghum silage figured at 35 percent dry matter.
[b] Supplement figured at 48 percent crude protein.

Table 7. — Suggested Creep Rations

	Rations				
	1	2	3	4	5
	(Percent)				
Shelled corn	100	50		60	90
Oats		50		35	
Ground ear corn			90		
Soybean meal			10	5	10
Percent Protein	9	10.5	11.6	12.0	13.0

The simple creep rations of grain or grain mixtures are usually adequate for nursing calves because they get enough protein, minerals, and vitamins from milk. However, a balanced creep ration may be needed when the cows are not giving enough milk in late lactation or when pastures are short.

Calves are able to chew whole corn and oats effectively, but coarse grinding or rolling might provide a more consistent mixture, particularly when a meal-type protein supplement is added. Milo and wheat should be rolled or cracked and should not replace more than 50 percent of the corn in a creep ration.

The creep rations in Table 7 can be self-fed and provide choices in protein and energy levels to meet varying needs.

When set up outside, the creep should be located where the calves have easy access to it. This could be near shade trees or the water supply. Feeders should be covered to protect the feed from wind, rain, and contamination. Self-feeders are usually the most convenient to use and should have feed in them at all times. They should be checked every day or two to be sure the feed is working down properly and should be kept clean.

Implants for Suckling Calves

Research results have shown an additional 15 to 25 pounds in calf weaning weight when calves were implanted with 12 or 15 milligrams of stilbestrol at three months of age. The effects of the implant are depleted after four to five months, and steer calves should be reimplanted after weaning. Implanting with stilbestrol is not recommended for breeding females, but experimental results have shown little or no effect on breeding performance of heifers implanted with 12 milligrams at three months of age. Ralgro (zeranol) is another implant cleared for use on suckling calves and the level permitted is 36 milligrams, the same as for older steers and heifers in the feedlot. The results from the use of Ralgro may equal or exceed those obtained with stilbestrol.

Management of Replacement Heifers

Heifer calves that may go into the breeding herd should be fed to gain 1 to 1.5 pounds per day after weaning. Yearling heifers selected for the breeding herd should continue to gain 1 to 1.5 pounds per day and should weigh a minimum of 650 pounds if they are bred at 15

Table 8. — Daily Nutrient Requirements of Growing Heifers

Body weight	Daily gain	Crude protein	TDN	Calcium	Phosphorus
	(Pounds per day)				
300	1.65	.87	5.1	.038	.029
400	1.65	1.19	7.3	.039	.030
500	1.1	1.39	7.9	.030	.025
600	1.1	1.65	9.4	.032	.030
700	1.1	1.85	10.8	.034	.034
800	1.1	1.94	11.9	.037	.037
900	.55	1.43	9.9	.032	.032

Table 9. — Daily Rations for Heifer Calves (500 Pounds)

	Rations				
	1	2	3	4	5
	(Pounds per day)				
Legume-grass haylage	25				
Legume-grass hay		10	10		5
Corn silage				30	20
Ground ear corn		4			
Corn			3		
Supplement[a]				1	

[a] Supplement contains 48 percent crude protein.

Table 10. — Rations for Bred Yearling Heifers (800 to 900 Pounds)

	Rations				
	1	2	3	4	5
	(Pounds per day)				
Corn silage	45	25			
Legume-grass hay		10	20		15
Legume-grass haylage				35	
Corn					3
Supplement[a]	1.5				

[a] Supplement contains 48 percent crude protein.

Table 11. — Daily Nutrient Requirements of Bulls for Growth and Maintenance

Body weight	Daily gain	Crude protein	TDN	Calcium	Phosphorus
	(Pounds per day)				
600	2.3	2.60	11.8	.053	.040
700	2.2	2.72	12.7	.050	.040
800	2.1	2.83	13.6	.045	.040
900	1.9	2.98	14.4	.042	.040
1,000	1.7	3.25	15.0	.044	.043
1,100	1.5	3.52	15.3	.046	.046
1,200	1.4	3.45	15.5	.046	.046
1,300	1.2	3.17	15.3	.046	.046
1,400	1.0	3.12	15.4	.048	.048
1,500	.8	3.11	15.7	.050	.050
1,600	.5	2.87	14.8	.048	.048
1,700	.2	2.45	13.4	.043	.043
1,800	.0	2.21	12.5	.040	.040
1,900	.0	2.29	13.0	.041	.041
2,000	.0	2.37	13.5	.042	.042

months of age (Table 8). Bred heifers should gain about 1 pound per day on pasture and 0.75 to 1 pound per day through the wintering period if they are to develop normally themselves and produce and deliver healthy calves at two years of age. Adequate protein and energy must be supplied to bred heifers through the wintering period and especially after calving if they are to come back into heat and rebreed in a reasonable time period.

The wintering rations in Table 9 for 500-pound heifer calves should result in a rate of gain of 1 to 1.5 pounds per day.

The rations in Table 10 for 800- to 900-pound bred yearling heifers should allow a gain of 0.75 to 1 pound per day during the wintering period prior to calving. Avoid feeding levels which make heifers and developing fetuses too fat for easy calving.

Management of Growing and Mature Bulls

Development of bull calves requires palatable and well-balanced rations. Enough grain should be fed to effectively measure the growth potential of the bulls up to a year of age but enough roughage should be fed to maintain the health of the animals and to keep them from getting too fat. Liberal grain feeding from weaning to 12 or 14 months of age will not reduce the breeding ability of the bulls if they are not overfed after that period. Bulls that are grown properly should be ready for limited breeding service by the time they are 15 to 18 months old. They will continue to grow but at a decreasing rate until they are about four years old.

The nutrient requirements for bulls at different ages and growth rates are listed in Table 11.

Weaned bull calves can be grown on combinations of grain with corn silage or hay or haylage. Good quality corn silage will be about half grain on a dry-matter basis and a feeding program of 1 percent of the bodyweight daily of grain plus a full feed of corn silage will allow growth at near maximum rates. Grain at about 1.5 percent of the bodyweight plus a full feed of hay or haylage would produce similar results. Use a supplement when necessary to insure adequate daily intake of protein, minerals, and vitamin A. A daily allowance of 30,000 to 50,000 international units (I.U.) of vitamin A would be appropriate for bulls getting primarily corn silage or limited amounts of good quality hay. Free-choice mineral mixtures would insure adequate mineral intake.

Where grinding and mixing equipment is available, mixed rations such as those in Table 12 can be prepared

Table 12. — Mixed Rations for Weaned Bull Calves

	Rations				
	1	2	3	4	5
			(Percent)		
Corn	60	60	50		
Oats		30	23.5		
Molasses			5		
Ground ear corn				78.5	85
Ground alfalfa-grass hay	30				
Dehydrated alfalfa			10	10	
Wheat bran			5		
Soybean meal	10	10	5	10	15
Urea			.5	.5	
Dicalcium phosphate			.25	.25	
Limestone			.25	.25	
Trace-mineralized salt			.5	.5	
Percent protein	13.5	13.5	13.7	13.6	13.1

Weaned bull calves on a performance test can be fed with self-feeders if enough roughage is included to keep them from going off feed. Some bull calves will get too fat with self-feeding. (Fig. 7)

for self-feeding or hand-feeding of bull calves (Fig. 7). Note that some of these formulas do not supply all of the needed roughage, minerals, and vitamin A since these items can be provided separately. Even if minerals are included in the mixture, it is a good practice to provide them on a free-choice basis. Obviously the main protein, mineral, and vitamin ingredients could be replaced by a commercial supplement supplying similar levels of nutrients. Vitamin A could be included in mixed rations at the rate of 2,000 I.U. per pound if ingredients high in carotene or vitamin A are not fed.

Yearling bulls should gain 1½ to 2 pounds per day, depending on how well they were fed up to a year of age. During the winter, grain at 0.5 to 1 percent of bodyweight may be needed daily unless good quality corn silage is fed.

Thin mature bulls will need 5 to 6 pounds of grain daily in addition to the wintering rations listed for cows, especially during the 6 to 8 weeks prior to the start of the breeding season. Extra protein may not be needed if legume-grass roughage is average or better in quality.

Mineral Needs of the Beef Herd

Calcium, phosphorus, and salt must be supplied in adequate amounts to the beef herd. Legume roughages are usually good sources of calcium and may supply enough phosphorus to meet animal needs as well. However, simple mixtures should be offered free-choice to allow for variation in animal requirements and in feed quality. Salt can be offered separately or incorporated into a loose mixture with other minerals. Salt and mineral blocks are convenient to use, but may be more expensive than loose mixtures prepared on the farm. However, loose mixtures should be protected from the wind and snow. The formulas in Table 13 have been used successfully for many years on Illinois farms.

A mixture of 50 percent trace-mineralized salt and 50 percent dicalcium phosphate would contain about 13 percent calcium and 9 percent phosphorus. If steamed bone meal is used in place of the dicalcium phosphate, the phosphorus content of the mixture would be 6 percent and the calcium content about the same. The use of limestone in a mixture increases the calcium content and is more appropriate for high grain rations.

Since deficiencies of trace minerals have seldom been reported in Illinois, our feeds apparently contain enough of these elements. Individual trace minerals can be offered free-choice, but there has been little research to show the need for this practice or the economic benefits from it. Trace-mineralized salt offers some insurance against trace mineral deficiencies and should be sufficient in most cases.

Vitamin A for the Beef Herd

The carotene content of feeds varies with feed quality. Beef cows receiving medium- to good-quality forage showing some green color usually get enough carotene to meet their vitamin A needs. If the summer pasture has been good, beef cows will store considerable vitamin A in their livers and thus they would be able to eat low-quality roughage for several months without needing additional vitamin A. However, if there is some doubt about the vitamin A adequacy of the ration or of the fall and winter

Table 13. — Free-Choice Mineral Mixtures

	1	2	3
Trace-mineralized salt	100 lb.	100 lb.	100 lb.
Steamed bone meal	100 lb.		
Dicalcium phosphate		100 lb.	100 lb.
Ground limestone			100 lb.
Total	200 lb.	200 lb.	300 lb.
Percent calcium	13	13	21
Percent phosphorus	6	9	6

pasture, the supplying of 30,000 I.U. of vitamin A per head daily during the last month of pregnancy would be cheap insurance against weak calves and rebreeding problems in the cows. Vitamin A can be supplied by feeding, but an alternate method would be the injection of 1 to 2 million I.U. of vitamin A one month before calving.

Nutrient Content of Feedstuffs

The nutrient contents of commonly used feedstuffs are presented in Table 14. The protein content of feeds can be expressed as crude (total) or as digestible protein, but crude protein is normally used in figuring rations because digestibility does not vary significantly in good quality feeds. However, the digestibility of protein is low in mature, low-quality roughages such as straw, corn cobs, or dry cornstalks, and crude protein levels should be ignored in this type of feed.

The approximate energy value of a feed is described as total digestible nutrients (TDN). The TDN of a feed is the sum of all of the digestible organic nutrients, including nitrogen-free extract (NFE), fiber, protein, and fat. The fat is multiplied by 2.25 because of the higher concentration of energy in fat. The maturity and quality of a forage plant will affect its TDN level. For example, good quality corn silage at 30 percent dry matter may contain 20 percent TDN, while corn silage with a low grain content may have only 15 percent TDN.

The nutrient contents of feeds should be adjusted for significant variation in moisture content. For example, corn silage is listed in Table 14 at 30 percent dry matter. If corn silage contains 40 percent dry matter, the listed nutrient contents must be multiplied by 40/30 or 1.33. Alfalfa haylage is listed at 60 percent dry matter. If haylage contains only 50 percent dry matter, the listed nutrient contents must be multiplied by 50/60 or 0.83.

Table 14. — Nutrient Content of Commonly Used Feedstuffs

	Dry matter	Crude protein	TDN	Calcium	Phosphorus
Dry Roughages (Percentages)					
Alfalfa hay, all analyses	90.5	15.3	50.7	1.47	.24
Alfalfa-grass hay	89.6	12.0	48.3	1.18	.24
Alfalfa meal, dehydrated	92.7	17.7	54.4	1.60	.26
Bromegrass hay	88.8	10.4	49.3	.42	.19
Clover-timothy hay	88.1	8.6	51.0	.69	.16
Ladino clover hay	89.5	18.5	59.5	1.53	.29
Lespedeza hay	89.1	13.0	46.4	1.00	.19
Red clover hay	88.3	12.0	51.8	1.28	.20
Corn cobs	90.4	2.3	45.7	.11	.04
Fescue hay	89.2	7.0	52.7	.45	.20
Mixed hay, under 30% legume	89.2	8.4	47.8	.59	.18
Oat straw	89.8	4.1	44.8	.24	.09
Soybean hay	88.1	14.6	48.6	1.10	.22
Timothy hay	89.0	7.6	51.7	.41	.21
Wheat straw	92.6	3.9	40.6	.15	.07
Silages and Haylages (Percentages)					
Alfalfa, wilted	36.2	6.3	21.5	.51	.12
Alfalfa haylage	60.0	10.4	35.8	.84	.20
Corn silage	30.0	2.4	21.0	.08	.06
Forage sorghum, sweet	25.4	1.6	15.2	.08	.06
Grain sorghum silage	29.4	2.3	18.0	.07	.03
Grass silage, wilted	37.3	4.0	21.1	.32	.08
Grass-legume silage	25.6	3.6	15.5	...	...
Husklage (husks and cobs)[a]	45.0	1.5	25.0	...	...
Oat silage	31.7	2.7	16.9	.10	.09
Sweet corn cannery waste	22.4	2.0	16.1	...	...
Sorghum-sudan	25.0	2.5	14.7	.16	.05
Stalklage (corn stover)[a]	45.0	2.0	22.5	...	...
Concentrates (Percentages)					
Barley	89.3	11.8	75.6	.06	.40
Corn, No. 2	85.0	8.7	80.1	.02	.27
Corn and cob meal	86.1	7.4	73.2	.04	.22
Cottonseed meal	91.4	41.6	66.1	.15	1.10
Linseed meal	90.9	35.1	71.0	.40	.83
Oats	90.2	12.0	68.0	.09	.33
Rye	89.5	12.1	76.5	.10	.33
Sorghum, milo	89.0	10.9	79.4	.03	.28
Soybeans	90.0	37.9	87.6	.25	.59
Soybean meal, solvent	89.3	45.8	77.2	.32	.67
Urea	100.0	281.0	...	...	...
Wheat, soft	89.2	10.2	80.1	.04	.29
Wheat bran	89.1	16.0	65.9	.14	1.17
Minerals (Percentages)					
Dicalcium phosphate	...	...	...	26.0	18.0
Limestone	...	...	...	38.0	...
Steamed bone meal	...	...	...	24.0	12.0

[a] Nutrient content estimated from only a few analyses.

Yearly Management Systems for Beef Cow Herds

Summer and Winter Grazing

The typical Illinois beef herd is pastured during spring and summer and is allowed to graze crop residues or diverted acres for as long as possible during fall and winter. Supplemental feeding is used when the weather is bad or when grazing does not supply enough feed. Grass pastures often provide enough excess forage so that a hay crop can be taken off part of the acreage and either stored for winter feeding or left in the field as round bales for the cows to eat in winter. In an open winter, cows grazing cornstalks, sorghum stover, or other forage may not need additional feed until a few weeks before calving.

Beef cows on a grazing system do not require shelter in winter if they have areas to get out of the wind. Thus investments in equipment and facilities are minimal. Calving takes place in the spring on pasture or in wooded areas, unless calving trouble is anticipated.

Drylot

The harvesting and feeding of forage can increase carrying capacity 50 to 100 percent over pasturing, but the additional costs for labor and equipment associated with drylot feeding may more than offset the advantage of utilizing more of the crop. Beef cows have been maintained successfully in drylot the year around, but a high level of management is required to avoid bacterial scours in young calves kept in drylot. The baby calves can be kept separate in clean quarters and allowed to nurse two times a day if scours are a problem. Conception rates and weaning weights have been as good with drylot as with pasture programs, and cow longevity has been better in some drylot tests because of fewer accidental deaths. Dry-

lot handling permits extensive use of artificial insemination and close observation of the herd.

Combination of Grazing and Drylot Systems

Some Illinois beef herds are fed in drylot during late winter and early spring, but allowed to graze during the rest of the year. This allows for mechanized feeding of stored feeds during a time when grazing would not meet the needs of the cows or when it would be poor management to have the cows out.

Another combination is to maintain cows in drylot during the summer when pasture is not available, but to allow them to graze crop residues in fall and winter. This system would make it possible to use green chopping of forage during the drylot period if stored feeds are not available. Also, this system would be ideal for the use of artificial insemination to produce spring calves.

Management From Calving to Weaning

Close observation of the cow herd at calving time is essential so you can provide assistance when needed. First-calf heifers will usually have more calving difficulty than older cows and therefore should receive close attention during the calving season.

Calving-Time Suggestions

1. Have cows in an area that can be checked easily.
2. Keep the cows in a clean area or facility during calving (Fig. 8).
3. When a cow has difficulty calving, examine her to find out whether the calf is being delivered in a normal position (head between and slightly above the front feet). If difficult birth is evident, you may wish to contact your veterinarian promptly. Difficult calving may be caused by any of the following conditions:
   a. The calf is extra large, especially its shoulders or hips, or both.
   b. The cow has a small pelvic area.
   c. The cow fails to dilate.
   d. The calf comes backward (breech birth).
   e. One or both front legs are bent back.
   f. The head is bent back.
4. Disinfect the navel with a 2-percent iodine tincture solution.
5. Be sure the cow claims her calf and permits it to nurse since it is essential that a calf receive colostrum soon after birth. You will often have to help a calf nurse a dam that has very large teats or an udder that hangs very low. Also, you should help weak calves nurse.
6. Have facilities available to pen a cow and her calf if needed.
7. If cows fail to clean properly (retained placenta), within 12 to 18 hours after calving, contact your veterinarian.
8. Keep the cows that have calved separate from those that are still to calve.
9. Keep a close watch for signs of mastitis or injury to udders. You may have to milk out a few cows for the first couple of days after calving.
10. Be sure the cow herd has access to plenty of clean, fresh water.
11. Ear tag or tattoo the calf and record information on your calving record. Also make a note of such information as ease of calving, abnormalities, availability of colostrum, strength of calf, birth weight of calf, and temperament of the cow.

See the section on animal health (page 15) for more specific information on calving.

Castration

Castration time will vary from farm to farm and will be different for a commercial than for a purebred production program. Some producers use elastrator bands when the calves are only a few days old; some use a knife or burdizzo (clamp) when the calves are three to four months old. Others wait until weaning time to castrate. The commercial cow herd owner should castrate all bull

Calving that takes place on clean ground will result in less trouble with calf scours than calving in buildings or contaminated lots. (Fig. 8)

calves before weaning and preferably before they are four months old.

Most purebred breeders who raise bulls for sale may wish to wait until after weaning to castrate bull calves, so they can evaluate weaning weights and use them in their bull selections. However, poor quality purebred bull calves should be castrated. Just because they are purebreds doesn't make them good herd sire prospects.

Bull calves will weigh more at weaning than steer calves; however, younger calves are easier to restrain for castration and are affected (set back) less than older ones.

Bull calves and staggy-looking steer calves will not be accepted in many feeder cattle sales. If sold as feeder animals they usually bring a reduced price.

The use of a knife or open castration assures complete removal of the testicles. There is, however, some risk in hemorrhage and post-castration infection. Poor technique with the burdizzo or elastrator results in incomplete castration and price discount. With the elastrator you must be sure that both testicles are below the band. With the burdizzo both cords must be completely crushed.

Dehorning

Dehorning is justified on an economic basis, because horned calves often bring lower prices at feeder cattle sales or in many cases are not accepted at such sales. In addition, dehorned and naturally polled animals do less damage to facilities and other animals than cattle that have horns. Horn removal may be accomplished by the following means:

1. Mechanical. A tube, spoon, or Barnes-type dehorner may be used.
2. Electrical. Electrically heated irons have been used with good results.
3. Chemical. Liquids, pastes, or caustic sticks can be used for dehorning, but should be used with extreme caution. Chemical dehorning materials should be allowed to dry before a calf is returned to its mother. This type of dehorning must be done when the calves are very young (less than two weeks of age).

If dehorning is done during the fly season, a good fly repellent must be applied.

Management Programs for Weaned Calves

Selling Feeder Calves

Spring-dropped calves can be weaned and sold as feeder calves in the fall when they are seven to eight months old. Weaning weights for steer calves typically fall in the range of 400 to 500 pounds, but heavier weaning weights can be obtained depending on the breeding and management of the herd. Heifer calves normally weigh about 5 percent less than steer calves. Creep feeding of calves, at least for the last couple of months prior to weaning, will put more "bloom" on the calves and increase their sale weights.

Fall-dropped calves will weigh as much as spring calves at weaning time if the cows are given sufficient protein and energy during winter. Creep feeding is often required for fall calves.

Selling Yearling Feeders

Calves can be fed economical growing rations to gain 1.5 to 2.0 pounds per day for about 150 days. This backgrounding results in yearling feeders which weigh 650 to 750 pounds and can be sold for finishing in other lots. This allows for sale of additional roughage and grain through cattle, but does not involve the high grain inputs normally required for finishing. Of course, more labor and facilities are required for feeding the calves, but growing calves can make excellent use of roughage produced on the farm and increase the production from the cow herd.

Fall-dropped calves can be weaned in the spring and grown on pasture before they are sold as yearling feeders in the fall.

Growing and Finishing of Beef Calves

Calves kept for finishing are usually wintered on corn silage or grain and roughage, followed by a finishing period of four to six months with higher levels of grain. Wintering calves will gain 1.5 pounds or more per day on growing rations. By the time heifers reach 600 pounds, replacement heifers should be sorted out and the remaining heifers should be given higher levels of grain during the finishing period. Depending on the breed, heifers will usually grade choice when they are 15 to 18 months old, weighing 850 to 950 pounds. Steers can be given a full-feed of grain when they reach about 700 pounds and fed until they grade choice at 16 to 18 months of age, weighing 1,050 to 1,200 pounds (Table 15).

Steers can be pastured without grain feeding if they are not too fat to gain adequately on pasture alone. In order to make the best use of the pasture, limit wintering gains to 1.5 pounds per day or less, and then feed no grain on the pasture as long as forage is plentiful and palatable. Grain feeding can be started on pasture, but final finishing is usually done in drylot. The steers will finish at a heavier weight if they are pastured before finishing with grain.

High-Energy Finishing Rations for Calves

Creep-fed calves that are placed on high-grain rations at weaning may be finished to choice grade before they reach desirable slaughter weights. However, there are some cattle which, as calves, have enough growth potential that they can be weaned at 500 to 600 pounds, placed on a high-energy ration, and finished at 1,000 to 1,050 when they are only 12 to 13 months old. Success of this system requires a beef herd with good growth and milk potential, good pastures and creep feeding, as well as the heavy grain feeding after weaning.

Intensification of the cow-calf program is probably better suited to the cornbelt than any other place in the country because of the abundance of forage and grain. The advantages of this system are lower overhead and maintenance costs for the young finished animal as well

Table 15. — Estimated Feed Needed per Year

	Daily gain, lb.	Hay system			Corn silage system		
		Hay, lb.	Corn, bu.	Supplement, lb.[a]	Corn silage, lb.[b]	Corn, bu.	Supplement, lb.
Beef cow (1,100 lb.)							
Pasture, 215 days	...						
Winter feed, 150 days	...	2,700			6,000		75
Creep feed per calf for 100 days	...		10			10	
Steer calf (450 to 1,050 lb.)							
Drylot, 270 days	2.2	1,500	65	150	5,000	50	360
Steer calf (450 to 1,100 lb.)							
Winter, 150 days	1.5	1,000	14		5,000		225
Pasture, 90 days	1.2						
Drylot, 120 days	2.7	600	40	120	2,000	35	120
Yearling steer (700 to 1,100 lb.)							
Drylot, 155 days	2.6	750	50	150	3,000	40	225
Heifer calf (400 to 850 lb.)							
Drylot, 240 days	2.0	1,200	50	150	4,000	40	300
Heifer calf (400 to 600 lb.)							
Winter, 150 days	1.3	750	12		4,000		150
Bull calf (525 to 900 lb.)							
Winter, 150 days	2.5	1,500	30	150	5,000	20	250
Yearling bull							
Winter, 150 days	1.5	3,000	20	150	8,000	10	250
Mature bull							
Winter, 150 days	.5	4,000	5	75	9,000		250

[a] Supplement figured at 48 percent crude protein.
[b] Corn silage figured at 35 percent dry matter.

as efficient utilization of forage and grain produced on a farm. For example, the roughage part of the corn plant would be used primarily for wintering beef cows, while the grain would be used primarily for finishing calves.

Cattle-Handling Facilities

Every cow-calf operation should have good handling facilities so cattle can be worked and sorted easily and efficiently. In developing a good set of facilities keep the following ideas in mind:

1. A permanent corral or holding pen should be located near the main livestock buildings with a working alley and several attached smaller catch pens to help in sorting cattle (Fig. 9).

2. If your pastures are a long way from the farm buildings, then you may want to have a permanent corral in the pasture or a portable corral that can be used anywhere you need it.

3. A headgate is a necessity on every cattle farm, as well as a chute leading to the headgate.

4. A portable loading chute may come in very handy.

5. Owning a good scale or having one readily accessible is also a must for the progressive cattleman. Several cattlemen in the same area may want to go together to buy a portable scale.

6. Plans for cattle-handling facilities may be found in the Beef Housing and Equipment Handbook prepared by the Midwest Plan Service and available at your county Extension office.

Cattle move through a curved alley better than through a straight alley because they cannot see what is ahead of them. A swinging gate is used to guide cattle into the head catch or up the loading chute. (Fig. 9)

Size, type, soundness, and health are factors to consider in purchasing a bull. Care must be taken to avoid introducing a disease to the herd through a bull. (Fig. 10)

ANIMAL HEALTH

Profits from a beef herd in today's economy are limited. The narrow margin should prompt every cow-calf operator to study his herd health program with a view to increasing efficiency and reducing losses.

Profits from a cow herd are related to the annual cost of maintaining a cow, percent of calf crop weaned, average weight of calves, and selling price of calves.

Investing a little time in a planned herd health program can pay dividends. This section on animal health includes a discussion of a few of the more current explosive diseases that you and your veterinarian can team-up to prevent. Emphasis is placed on the diseases transmitted by the "carrier" animals and management's role in prevention.

Continued research findings on cow-calf diseases will shed additional light on some of the present problems and will no doubt change some of the currently recommended practices.

Purchasing a Bull

Plans for adding a bull to the herd should be made well in advance of the breeding season. Planning ahead provides better opportunity to be more selective in your choice of sires. The new bull needs to spend four to six weeks on the farm adjusting to the new environment, disease level, and management procedures before being placed into active service.

Before purchasing a bull you should question the owner or his veterinarian about the health status of the seller's herd. A history of poor calving percentage might suggest the possibilities of certain breeding diseases such as leptospirosis, brucellosis, vibriosis, bovine virus diarrhea, or infectious bovine rhinotracheitis.

The bull being considered for purchase should be well developed for his age and structurally sound. For example, a bull with poor leg structure may have difficulty in trailing the cow herd. He will likely pass on this genetic weakness to his offspring. The testicles should be well developed and firm to the touch. A bull with soft, mushy, and underdeveloped testicles is likely to be a poor breeder and to transmit this weakness to his calves. A bull with a crooked penis should not be purchased as this problem likely means poor breeding performance (Fig. 10).

It is advisable to have a semen or fertility evaluation made before you buy the bull. Bulls with flighty or nervous temperament should not be considered for purchase. Heifers produced by a nervous bull and retained in the herd will likely exhibit nervousness and be difficult to handle.

Young bulls can be placed in service at 14 to 18 months of age on a limited number of cows in pasture breeding. Heavy service and poor pasture with no supplemental grain feeding during the first year may shorten his breeding career.

Immature bulls should be fed a grain ration to promote proper growth and development consistent with pasture quality and number of cows to be bred. Drouth, overpasturing, and poor quality pastures are situations in which grain supplementation is needed.

A bull used in a herd may be exposed to and a carrier of vibriosis, trichomoniasis, anaplasmosis, Johne's disease, and brucellosis.

State health regulations require that animals of breed-

ing age have a test for brucellosis within 30 days of the sale or originate in an accredited herd. If questions arise about inter- or intrastate movement of males or females, check with your veterinarian.

Suggested periodic management practices for bulls include:

1. External parasite control of lice and flies.
2. Fecal examination for internal parasites.
3. Foot examination and care if needed — trimmed, corns removed, treatment of foot infections and other injuries.
4. Eye examination and necessary treatment.
5. Reproductive examination and semen evaluation if needed.

Preventing Calf Losses

Carefully observe a heifer or cow near calving time so you can provide assistance if needed. Lending a hand when needed in simple delivery may mean the difference between saving and losing a calf. In really complicated cases, the services of a veterinarian are needed. Equipment used in delivery of the calf should be well organized and kept in readiness for emergencies. The "obstetrical kit" should include liquid soap (preferably in a plastic squeeze bottle), a soft bristle brush, plastic pails, obstetrical chains and mechanical calf puller, hooks, clean towels, and a bottle of iodine for disinfecting the navel cord. The animal which is delivering should be confined to clean sanitary quarters, particularly if calving in buildings. Permitting calves to be dropped in muddy lots is inviting disease problems. Installation of a heat lamp in a specially built calf box is recommended for use in cold weather to aid in drying of the new-born calf. If the weather is not too severe, calving in a clean pasture provides a healthier environment for the calf. First-calf heifers require much closer confinement and observation than cows that have already had one calf. Observing the heifers every two to three hours will result in a much higher percentage of live calves (Fig. 11).

The three stages of delivery are as follows:

Stage 1 — Initial uterine contractions and dilation of the cervix.
Stage 2 — Delivery of the calf.
Stage 3 — Expulsion of the membranes.

Initial uterine contractions in heifers may be difficult to detect unless you check the heifer or cow frequently. It is in stage 1 that the uterus begins to contract, the cervix dilates, and the calf is positioned for delivery. In this stage the animal may appear restless, nervous, and show some treading of the feet.

The unborn calf at this stage is not in any grave danger. Forced delivery should not be attempted at this time.

The second stage is most familiar to cattlemen. Signs of straining are apparent. Straining becomes more active as the feet and head of the calf enter the birth canal. The fluid-filled sac or membrances covering the feet are visible unless previously ruptured. Straining at this stage

A healthy, vigorous calf is essential for a successful beef cow operation because the percentage of calves saved is the most important factor affecting profitability. (Fig. 11)

is frequent and active delivery should be accomplished without delay.

The common causes for assistance are very large calves, breech presentation (calf coming backwards), and leg or head turned back. In normal delivery, if the cow should be in labor for more than two to three hours and the cervix appears dilated and relaxed, yet no part of the calf is visible, then veterinary assistance may be needed. Contractions are often weak or absent when a calf is in breech position or when its front feet or head is turned back.

If progress is not normal and the cervix is dilated, you may wish to examine the cow to determine the position of the calf. Before examining, however, wash the vaginal area with soap and water. Clean and sanitize your hands also. Next use an appropriate disinfectant on the animal and your hands and arms. Evaluate the position of the calf and make any simple correction before applying traction. When the calf is in normal position (forefeet and head in the birth canal), traction may be needed if the calf is too large. Traction should be applied slowly to prevent tearing of the vaginal wall. Forcing a large calf through a small pelvic opening may result in death of the calf and paralysis of the cow. All dystocias (difficult deliveries) that cannot be easily corrected will require the services of a veterinarian.

Being present at delivery and applying a few calf-saving practices will help increase the profits in a beef herd. Quick removal of the mucus from the calf's mouth and nose will facilitate breathing. A clean cloth or towel should be part of a packet which you keep for emergencies.

Holding the calf by the rear legs -- if it is not too heavy — and shaking thoroughly helps start breathing. Artificial respiration may be applied to the calf's rib cage if breathing is not apparent. Oxygen is needed for calves that do not respond to routine procedures. The

Heifers bred to calve at 24 months of age must be properly developed to reduce the calving problems associated with first calving. (Fig. 12)

navel cord should be dipped in tincture of iodine. A plastic syringe (without needle) is best for injecting the iodine inside the umbilical membranes.

Helping the calf nurse within 15 minutes after birth is important in providing colostrum which contains the dam's disease prevention antibodies. Keeping a gallon of colostrum in a plastic jug in the deep freeze assures ample supply in emergency cases. The colostrum can be given to the new calf with a 4-ounce-dose syringe. This reserve colostrum supply can be obtained from a dairy producer.

During the third stage — explusion of the membranes — if there is uterine prolapse, a veterinarian should be contacted promptly. Generally, the fetal membranes are expelled within 2 to 12 hours after birth. Methods of handling retained placentas differ with veterinarians. Manual removal, plus use of broad-spectrum antibiotics, is generally practiced.

On some farms where calf losses are high or in the case of new-born calves that have been stressed, you may want to use antibacterial serum, antibiotics, and anti-diarrheal tablets on the advice of your veterinarian.

Season of Calving

The breeding date should be planned in advance to assure arrival of the calf at the optimal season for survival. Calves arriving during winter or early spring may require housing facilities or maternity quarters which should be clean, dry, and draft free. Calves born in the fall generally require no housing, but will need access to a creep or supplemental feeding since the quality of forage and milk production of a dam is not comparable to her performance on spring pasture.

Heifers bred to calve at 24 months of age must be fed an adequate ration for growth and pelvic development. Research has proven that heifers fed a high-energy ration will cycle more regularly and their calving season may be advanced by two or three months. Studies at the Fort Robinson, Nebraska, station have shown consistent increases in pregnancy rates when first-calf heifers are supplied adequate energy following calving. Heifers that produce their first calves late in the calving season continue to calve late in succeeding calvings and have a lower lifetime pregnancy percentage. Reproductive performance in mature cows is likewise correlated to feed levels during the winter season and post-calving periods (Fig. 12).

Calf Scours

Calf losses from scours (diarrhea) and the pneumonia complex represent a serious economic problem in beef herds. Stress, housing, nutrition, and weather combined with bacterial and viral agents represent the primary cause of diarrhea, recognized as the major killer of calves.

E. coli (colibacillosis) is responsible for more than 80 to 90 percent of the cases of infectious calf diarrhea.

Many strains or serotypes of *E. coil* are ingested by the calf soon after birth. When confined to the lower digestive tract *E. coli* is generally harmless.

Events which account for a buildup of pathogenic (harmful) strains of *E. coli* include:

1. Failure of the newborn calf to receive colostrum during first few hours.
2. Dirty udder and teats of dams, a reservoir of *E. coli.*
3. Stress, weather, and wet bedding.
4. Intermittent feeding, leading to engorgement with milk and gastric disturbance.
5. Proliferation of *E. coli* bacteria following intestinal upset.
6. Diarrhea and dehydration.
7. Virus invasion jointly with *E. coli.*

Measures which can prevent the buildup of *E. coli* are:

1. Make certain the calf nurses within the first 15 minutes of life.
2. Maintain the cow and calf in dry, clean quarters.
3. Consider injecting bovine antibacterial serum at birth.
4. Administer an injection of vitamins A, D, and E.
5. Inject the newborn calf with an antibiotic if it has been stressed.
6. Give anti-diarrheal tablets or capsules on both the first and second days after birth.

To treat scours, ask your veterinarian for a scour formula or medicine that includes electrolytes, fluids, and soothing agents. Here is a fluid replacement mixture that is easy to prepare:

1 teaspoonful	sodium chloride (salt)
½ teaspoonful	sodium bicarbonate
8 tablespoons	white corn syrup

Add to 4 pints of water. Make certain the calf receives at least 4 pints daily for two days. During this time do not permit the calf to nurse its mother. If the calf nurses, the milk will contribute to bacterial buildup. Antibiotics and soothing agents are given during this two-day treatment.

As the scours cease, the calf may receive a limited amount of its mother's milk. Your veterinarian may substitute other suitable or commercial medicines containing electrolytes

Bovine Abortions

Abortion in cattle is a very puzzling aspect of reproductive failure. When abortions occur in a herd, check for infectious agents such as brucellosis, vibriosis, trichomoniasis, and leptospirosis. If these diseases are not present, check for certain viruses, IBR,[1] BVD,[2] and PI3.[3] Molds and toxic plants also cause abortion.

The most reliable methods to establish a positive diagnosis are examination of a fetus, portions of a fresh placenta, and blood from the dam. If the services of a diagnostic laboratory are needed, the entire fresh fetus and a generous portion of the placenta should be packed in a plastic bag in ice and delivered promptly to the laboratory. A serum sample taken from the dam at time of abortion and a second in two weeks should be collected by your veterinarian and sent to the laboratory. Your veterinarian is familiar with this procedure. Additional information about diseases known to cause abortions is included in Table 16.

[1] Infectious bovine rhinotracheitis.
[2] Bovine virus diarrhea.
[3] Parainfluenza-3.

Brucellosis

Because of extensive eradication efforts of state and federal agencies, brucellosis has become a "minor" disease in most counties. It should be emphasized, however, that as long as any reactors show up in our beef and dairy herds a serious potential threat exists. Laxity in testing herd replacements could be disastrous in an individual herd.

The use of strain 19 brucellosis vaccine for immunization of heifers against the disease is being phased out of the eradication program. Persistent vaccinal titers (indistinguishable from natural infection) have resulted, particularly in the vaccination of heifers beyond six months of age. Its use in closed herds is questionable, since there is very little danger of exposure.

Bull calves should not be vaccinated for brucellosis. Research has proven that male calves vaccinated at the ages recommended for calfhood vaccination (three to six months) may develop genital organ abnormalities, retention of strain 19-like organisms, and a persistent blood titer.

Breeders of purebred cattle often market their calves in states where the regulations differ from those of Illinois. For this reason the breeder and his veterinarian may follow a specific vaccination program to qualify cattle for export sales.

Vibriosis

Vibriosis is a serious reproductive disease of beef cattle causing high incidences of embryonic mortality. The disease spreads from bull to cow during breeding.

Signs of the disease are repeat breeding (three or more services), delayed conception, and low rate of abortion. Bulls can be carriers of vibrio, but show no clinical signs. Any vibrio-suspected bull certainly should not be used on virgin heifers or clean cows.

A cow with the disease will eventually build up resistance and settle. A cow can be reinfected or she may remain a carrier and a reservoir of infection for over a year. Delayed breeding season in a herd, however, can be costly.

The disease is diagnosed in the females by history, laboratory examination of the cervical mucus, and isolation of the vibrio organism from a recently aborted fetus. This disease causes death and absorption of the embryo and produces a very low abortion rate.

Preventive measures consist of adding virgin heifers and unused or clean bulls to the herd. The vibrio vaccine has given good results in field use. Annual vaccination of

Table 16. — Diseases Known To Cause Abortion

Disease	Causative organism	Time of abortion	Samples needed for diagnosis	Vaccines available
	(BACTERIAL)			
Brucellosis	Brucella abortus	6–7 months	1. Blood sample from aborting cow 2. Fetus and placenta	Live vaccine (give to heifers 3–5 months old)
Leptospirosis	Leptospira pomona	7–9 months (within 6 weeks after infection)	1. 2 blood samples from aborting cow 3 weeks apart 2. Fetus and placenta	Killed vaccine (immunity 6–12 months)
Listeriosis	Listeria monocytogenes	6–9 months (severe inflammation of the uterus common)	1. Fetus and placenta 2. Uterine discharge	None
Salmonellosis	S. typhimurium S. dublin	6–9 months (placenta decomposed)	1. Fetus	None
Vibriosis	Vibrio fetus var. venerealis var. intestinalis	Usually 2–6 months	1. Fetus and placenta 2. Uterine discharge 3. Vaginal mucus	Killed vaccine (given 30–60 days before breeding)
	(VIRAL)			
Bovine virus diarrhea (BVD)		See discussion under BVD on page 20	1. 2 blood samples from aborting cow 3 weeks apart 2. Fetus and placenta	Modified live virus vaccine
Infectious bovine rhinotracheitis Infectious Pustular vulvovaginitis	IBR virus	7–9 months	1. 2 blood samples from aborting cow 3 weeks apart 2. Fetus and placenta	Modified live virus vaccine (intranasal or intramuscular types) or killed vaccine
Malignant catarrhal fever	MCF virus	Anytime	1. Nasal swabs	None
Parainfluenza-3	Parainfluenza-3	Anytime	1. Blood sample	Killed and modified live virus vaccine
	(FUNGAL)			
Mycotic abortion	Aspergillus, Mucor, Candida, Rhizopus, Absidia spp.	6–8 months (placenta often retained)	1. Fetus and placenta	None
	(PROTOZOAL)			
Trichomoniasis	Trichomonas fetus	2–4 months	1. Fetus 2. Preputial washings 3. Vaginal discharge	None
	(PPLO's)[a]			
Mycoplasmosis	Mycoplasma bovis	7–9 months in experiments	1. Fetus and placenta	None

[a] Pleuro pneumonia-like organisms.

both heifers and cows three to six weeks before breeding is recommended.

Artificial insemination should be practiced with positive vibriosis bulls. Treatment of the semen with antibiotics is recommended. Treatment of positive bulls is an expensive course to follow and the advice and services of a veterinarian should be sought.

Infectious Bovine Rhinotracheitis (IBR, Red Nose)

IBR is a virus disease of cattle that appears to be widespread in Illinois herds. It exists in five forms (Fig. 13).

Respiratory IBR. This is probably the most common form. It causes mild or severe inflammation of the upper respiratory passages. The infection is accompanied by heavy nasal discharge, foaming salivation, open-mouth breathing, coughing, elevated temperature, and loss of weight. The membranes lining the nose become very inflamed, giving rise to the term "red nose."

Infected animals may harbor the virus and transmit it to susceptible animals for several days or even months following recovery. The number of animals affected in an outbreak is variable, depending on each animal's susceptibility. If susceptible animals are added to a carrier herd, the outbreak may involve 100 percent of the additions.

Genital IBR. This form of IBR, called IPV, Infectious Pustular Vaginitis, causes inflammation in the vagina and swelling of the vulva. Pustules or pus forming blister-like nodules appear in the vagina. A pussy discharge is observed from the vagina. The course of the genital form of IBR is from three to eight weeks.

The genital form of IBR in the bull is referred to as infectious pustular balanoposthitis (IPB). This causes inflammation of the sheath and glans penis with pustular discharge. IPB in the bull is frequently more severe than IPV in the cow because of secondary bacterial invasion. Distortion of the penis caused by adhesions often results following infection in the bull. If the IBR virus is introduced into the vagina of a susceptible cow by an infected bull, a severe inflammation of the vagina could develop in one to three days after breeding.

A blood sample can be used to diagnose many viral and bacterial diseases. Your veterinarian can take these samples easily if you have simple devices for restraining the cattle. (Fig. 13)

Conjunctival IBR. This form resembles "pinkeye," except that the typical "corneal ulcers" are rarely seen. The discharge from the eye is clear initially, then becomes "pussy" as bacterial agents move in.

Abortion and IBR. In many of the unexplained abortions in beef herds, IBR may be responsible. Research workers report that the IBR virus crosses the placental barrier around the fourth to fifth month of gestation. The fetus is infected, dies, and is aborted three to five days later.

It is known that the modified live virus vaccine can cause abortion between the sixth and eighth month of pregnancy. The modified live virus vaccine should not be used in pregnant animals.

Encephalitic IBR. IBR virus can localize in the brain and cause incoordination, depression, convulsions, and death. It is usually seen in younger calves.

Diagnosis of IBR. Various methods of diagnosis are used by diagnostic laboratories. One method requires virus isolation studies of kidney, liver, lung, and placental fetal tissues from an autopsied animal. Tissues must be delivered fresh to a laboratory or the fetus must be placed in an iced plastic bag and delivered promptly.

Nasal, rectal, and eye swabs may be taken from sick animals to be used for isolation studies. This method is of little value in checking for abortion because IBR has been in the herd for several months and an increase in titer in paired samples would not be apparent.

Prevention. IBR can be controlled by maintaining protective levels of antibody in a herd and by reducing the number of susceptible animals to a minimum. A dam with antibody titers will transmit the IBR antibodies to her calf in the colostrum within the first 24 hours after birth. If the dam possesses no antibody titers, no protective antibodies will be transmitted. This antibody titer level can be provided in the cow by vaccination at least two weeks before breeding.

Calves receiving colostrum within 15 minutes after birth will receive a high level of antibodies which may persist as long as four months. This persistence would prevent any antibody response to vaccination; therefore, the calf should not be permanently vaccinated before five to seven months of age.

The following recommendations will help combat IBR in your herd.

1. Test a cross section of your cow herd for IBR.
2. Isolate additions (heifers and cows) to the beef herd for 30 days.
3. Vaccinate any additions two weeks or more before adding to the herd.
4. Vaccinate breeding animals two to four weeks before breeding.
5. Vaccinate calves between six and seven months of age. The use of IBR modified live virus vaccine on calves before weaning and keeping them in contact with their pregnant dams has been questioned. The information to date indicates minimal risk of causing abortion of the pregnant dams.
6. Vaccinate simultaneously for IBR, PI3, and possibly BVD where indicated.

7. Use killed IBR vaccine in pregnant animals.

Treatment. The use of sulfanomides, antibiotics, and supportive treatment will help control secondary bacterial invaders.

Bovine Virus Diarrhea (BVD)

BVD is a widespread contagious disease of cattle which causes a variety of clinical signs. The disease can be divided into mild, acute, or chronic forms.

Mild form	*Acute form*	*Chronic form*
Fever	Fever	Laminitis — elongated hooves
Clear to mucus nasal discharge	Respiratory distress	Rough hair coat
Rapid breathing	Ulcers of mouth membranes	Loss of weight
Unproductive cough	Weight loss	Arched back
Intermittent diarrhea	Dehydration	
Slow weight gain	Drying and peeling of muzzle	
	Heavy eye discharge	
	Cloudiness of cornea	
	Difficult breathing	
	Acute laminitis	
	Diarrhea	

The mild form may not be diagnosed easily, but can account for heavy economic loss. BVD strikes suddenly, involving most of the herd. In the cow the clinical signs may be so mild as to go unnoticed. Abortions are frequently linked with BVD. Usually abortions occur in the herd after a history of a mild respiratory form of BVD or signs of diarrhea. The effects of the BVD on a fetus may result in abortion. The calf may be born with signs of brain derangement or be born apparently normal in appearance.

If the pregnant cow is infected with BVD during the first 60 days pregnancy, the fetus will die and be resorbed. If the virus infects the pregnant cow during the 90th to 120th days of pregnancy, the BVD virus may cause necrosis or damage to the brain cells of the fetus, resulting in underdevelopment of the cerebellum. An affected calf will exhibit signs of nervous disorder such as wobbly gait, twisting of the head, and frequent falling. BVD at this stage of pregnancy in the dam may also result in underdevelopment of the lungs in the fetus and may result in underdeveloped hair covering on the body.

Fetuses exposed during the middle of gestation are apt to become mummified. If exposed during late pregnancy the virus will not affect the development of the fetus. The calf will carry BVD antibodies at birth.

Prevention. A modified live virus vaccine has been available for several years for immunization. Its use has not always produced the desired immunity in a limited number of animals. One reason offered for the animals' intolerance to the vaccine is that the recipient may have the disease in the inactive form and not show any clinical signs. Such animals may be slow to develop antibody protection or totally unable to develop antibodies.

Treatment. Calves possessing maternal antibodies may be unable to develop an active immunity following use of the vaccine. The calves should be vaccinated near weaning when the maternal antibodies will be below the interference level. Vaccines should never be used in sick animals.

The modified live virus vaccine can be used in brood cows some three to four weeks prior to breeding. Pregnant cattle should not be vaccinated.

Modified live virus vaccines, IBR, PI3, and BVD, are available in various combinations. Because of the widespread prevalence of these viral agents in our cow herds, the combined vaccines are often preferred over the single vaccine. Under certain conditions one animal can be infected with more than one viral agent plus secondary bacterial invaders. Vaccines are being produced that also contain *Pasteurella multocida* and *Pasteurella hemolytica* in combination with the viral vaccines.

Shipping Fever

Shipping fever is one of the most common diseases of the bovine respiratory disease complex. It is an acute respiratory disease most common in calves following shipment, although it is frequently observed in calves that remain on the farm or ranch following weaning.

Signs of the disease include fever, a cough, clear to pussy eye discharge, dehydration, pneumonia, diarrhea, and even death. The fever may be from slight to 4 degrees.

Research workers have developed the following formula or combination of agents as the cause of shipping fever complex:

Stress +	*Viral infections* +	*Bacterial infection* = *Shipping fever*
Heat	Parainfluenza-3 (PI3)	Pasteurella spp.
Cold	IBR	Streptococcus spp.
Dust	Mycoplasma	Pseudomonas spp.
Trauma	Enteroviruses	Hemophilus spp.
Fatigue	Other viruses	
Dehydration		
Hunger		
Weaning		
Fright		

Prevention. Experimental studies have shown that stressed calves exposed to a combination of PI3 and Pasteurella organisms develop typical signs of shipping fever. Many of the stress factors are induced by man. With careful planning some of these stress factors could be reduced or eliminated. Weaning of calves and adjustment to grain feed before shipment would eliminate some big stresses. Planned management practices plus the use of vaccines — IBR, PI3, and possibly BVD — are the essentials of the preconditioning program. The practice of "backgrounding" young calves, an intermediate stop of several months on a farm rather than moving directly into contaminated feedlots, should minimize the chances of respiratory problems.

Treatment. Surveys have shown that the PI3 virus infections are widespread in our cattle population. An

uncomplicated PI3 infection rarely causes death. PI3 infections are often undetected in the herd. The presence of viral agents accompanied by stress leaves the membrane of the respiratory tract vulnerable to invasion by bacterial agents. The use of PI3 virus vaccines has been controversial. Many of the PI3 vaccines fail to stimulate the production of antibody titers. One of the newest types of PI3 modified live virus vaccines is administered by nasal spray. Protection or antibody response is developed within four to five days after intranasal vaccination. The protective mechanism of the epithelial cells through secretory neutralizing antibodies is reported to block the subsequent infection of the invading PI3 virus.

Give the intranasal vaccine at least one week prior to stress and potential infection. If you use killed PI3 virus vaccines, give a second vaccination two weeks later to provide higher antibody titers.

Pasteurella spp. The Pasteurella spp. are known to be associated with the shipping fever syndrome. These bacteria are responsible for the clinical signs of shipping fever and the pathological changes occurring in the lungs. It has been suggested that the Pasteurella organisms multiply and invade the tissues when the resistance of the mucous membranes is lowered by the presence of viral agents and stresses. Pasteurella bacterins have been used for many years as a preventive measure against shipping fever. Their effectiveness has often been debatable. The incorporation of specific types or strains of Pasteurella into bacterins has intensified the interest in the use of bacterins. Since bacterins are known to be poor producers of antibodies, a second injection of the bacterin two weeks later is strongly recommended.

Prevention. Several health practices are being used for the prevention and treatment of shipping fever. Low-level feeding of antibiotics in the feed is frequently practiced. The use of injectable antibiotics prior to shipping or on arrival is popular with many cattlemen. Some veterinarians administer antibacterial serums which also contain the viral fluids of IBR, PI3, and BVD, as a preventive and passive approach to guard against shipping fever.

Treatment. Early, adequate, and repeated treatments are indicated for successful response. Antibiotics and sulfas have long been recognized as standard treatment in outbreaks of shipping fever.

The best professional advice on prevention and treatment can be obtained from your veterinarian. The services of a veterinarian are needed to differentiate and aid in the diagnosis of the agents involved in shipping fever outbreaks.

Leptospirosis

Leptospirosis in cattle is caused by several strains or serotypes of leptospira. While the pomona strain is more frequently identified with cattle, *L. canicola, L. hardjo,* and *L. grippotyphosa* are sometimes involved. This disease causes loss of calves by abortion and results in lowered milk production. It affects cattle of all ages, with the highest mortality occurring in young cattle.

The disease localizes in the kidneys and is spread when the urine of infected animals contaminates the feed or drinking water.

Signs of leptospirosis include fever, loss of appetite, bloody urine, reduced milk flow, jaundice, and abortion one to two weeks after the initial infection. High levels of antibiotics are indicated in the early stages of infection.

Diagnosis of leptospirosis requires the services of a veterinarian and diagnostic laboratory assistance. Blood samples or aborted fetuses, or both, are sent to diagnostic laboratories for confirmation. It is essential to identify the serotype present in the herd in order that the specific vaccine can be used.

Prevention and treatment. Vaccination is recommended as a preventive measure. Unfortunately no multivalent vaccine incorporating all the serotypes into one injection is available. Control measures in an infected herd should be directed toward elimination of the sources of infection. These measures include:

1. Vaccinate all animals which are not positive.
2. Isolate sick animals.
3. Bury infected carcasses.
4. Do not add replacement stock earlier than three months after the last case.
5. Revaccinate animals every six to eight months.
6. Fence streams and ponds to minimize contamination.

Anaplasmosis

Anaplasmosis is a disease of cattle causing destruction of the red blood cells. Loss of red blood cells results in anemia, labored breathing, wasting away, and often death in mature cattle.

While the disease has long been recognized as a serious disease in the southwest, it is becoming much more common in Illinois and adjacent states.

Carrier animals are introduced into a herd. The small microscopically visible parasite is spread to susceptible animals by horseflies, stableflies, and mosquitoes. It is also spread by man through careless use of improperly cleaned and sterilized instruments, particularly bleeding needles, dehorners, nose leads, and tattooing instruments.

Animals vary in their susceptibility to anaplasmosis. It is seldom observed in calves under six months of age and may produce mild clinical borderline cases up to 12 months of age. Anaplasmosis in the acute form in bred heifers may produce high fever, icterus, some abortion, and a few deaths. Older animals are the hardest hit of any age group. In addition to fever, anemia, weakness, and drop in milk production, affected animals may stray from the herd and show nervous behavior when approached because of oxygen deficiency. For this reason, animals with this disease must be handled with care. Occasionally, an older cow is found dead in the pasture when the herd has not been observed carefully and signs have not been noticed.

The disease is diagnosed by signs and history supplemented with laboratory examination of blood samples. More recently research workers have been experimenting with an experimental rapid card test. The test can be

conducted at cowside with results available 10 minutes after the animal is bled. A disadvantage of the card test is its inability to detect newly infected animals until six weeks or two months after initial infection.

Prevention and treatment. Numerous drugs have been used in an effort to prevent and cure anaplasmosis. Most emphasis in recent years has been placed on the feeding of chlortetracycline-treated feeds for 30 days at a specific level. Results have varied from 80 to 90 percent successful. Cost of the drug per cow for this 30-day feeding period is $5 to $7. The addition of molasses to this antibiotic has increased palatability, but increases costs to $15 to $20 per cow for this 30-day period.

Veterinarians have used intravenous injections of tetracyclines in acutely ill animals with good results. A vaccine is available, but its use should be discussed with your veterinarian since limited field reports indicate a few newborn calves from vaccinated cows have died because of blood incompatibilities.

Johne's Disease (Paratuberculosis)

Johne's disease is a chronic infection in cattle that causes a thickening of the intestinal wall and a recurring persistent fetid diarrhea that results in loss of flesh and eventual death.

This disease is nearly always introduced into a clean herd by the addition of an infected animal. Before adding any bulls or females to your herd, have your veterinarian inquire if there is any history of chronic diarrhea or Johne's disease in the herd of origin. In questionable herds, a Johnin test can be conducted by your veterinarian.

Pinkeye of Cattle

Pinkeye (infectious bovine keratoconjunctivitis) is a common infectious disease of cattle. It is more commonly observed in younger cattle, particularly calves and yearlings, and in breeds having white faces or white pigment around the eyes. It may occur in any season and in all kinds of cattle, however the infection is highest during the period of maximal sunlight, although pinkeye has been reported during periods of heavy snowfall (snow blindness) and bright sunlight. Once established in a herd, severe losses in weight and production can occur. The pain associated with the infection often results in the animal refusing to graze. The disease generally runs its course in two to four weeks unless secondary bacteria invade and cause permanent blindness.

Cause and spread. Pinkeye of cattle is believed to be caused by the micro-organism *Hemophilus bovis* accompanied by a mixed group of organisms causing secondary infections. Sunlight, allergins in weeds, vitamin A deficiency, and foreign materials such as weed and grass seeds and awns may contribute to the cause. One form of the IBR (rednose) virus may cause mild to severe conjunctivitis.

Pinkeye is spread by contact between infected and susceptible animals by means of dust, tail switching, and insects. The presence of large numbers of face flies, houseflies, stableflies, and gnats are thought to contribute to the spread of the disease. Field studies have shown that recovered animals in the herd may serve as carriers of pinkeye while showing no clinical signs.

Signs. Pinkeye varies in its severity. In the mild form, the white part of the eyeball develops a pink cast due to increased blood circulation to the eye. The cornea (transparent covering of the iris and pupil) is slightly clouded. The mild form may clear up if the eye is treated and a cloth patch applied over the eye or the animal is isolated in a dark stall for a few days.

In the acute form of the disease, the primary signs are profuse flowing of tears and cloudiness of the cornea, often developing white or gray spots. If the infection continues, the cloudy condition becomes more pronounced, ulcers may develop, and severe eye damage may occur. Permanent blindness may result if treatment is neglected and exposure to sunlight is permitted. The disease may last three to four weeks or more and involve a high percent of the herd if preventive and control measures are not followed.

Preventing and treating pinkeye. The control of flies is important in preventing the spread of the disease. The use of dust bags, contact sprays, back rubbers, and feed additives is recommended. The feeding of low levels of phenothiazine or organic phosphates aids in the control of the fly population through destruction of the larvae in the manure. The two drugs should never be used jointly. Also, do not use an organic phosphate in any form if the cattle are on low-level phenothiazine; or if your cattle are on a low-level feed of organic phosphate, don't worm with phenothiazine.

No specific vaccines are recommended for prevention of pinkeye. Research on pinkeye vaccines is being conducted jointly by the College of Veterinary Medicine and the Dixon Springs Agricultural Center. Findings to date have been inconclusive.

Isolate affected animals to darkened quarters. Isolation of affected animals in a dark stall protects the sensitive eye from direct sunlight, thus alleviating pain. Water and feed are also more readily available.

A cloth can also be placed over the affected eye and held in place with rubber cement. A commercial patch is also available. The eye should be treated before applying the patch. The disadvantage of using the eye patch is the trend toward too little treatment and leaving the animal in the pasture to forage for grasses when "barn" confinement and making feed available would prevent weight loss. Also, accessibility of the animal makes for easier treatment (Fig. 14).

Non-irritating antibiotics available in commercial ointment, sprays, or dusts usually give good results if applied daily for two to seven days. The use of intraconjunctival injections of antibiotic ointment in combination with a steroid is recommended. Your veterinarian can assist you with this approach.

Internal Parasites of Cattle

The high cost of worms. Internal parasitism of cattle has long been recognized as an economic problem. Heavy

An eye patch is used in pinkeye treatment to protect the inflamed eye from sunlight. Periodic treatment should be used with the patch. (Fig. 14)

parasitism may cause stunting and unthriftiness, while light parasitism may not be clinically recognized, yet require extra feed for the animal to reach market weight. Worms can act as a constant drain on the vitality of the animal without producing definite disease symptoms.

Parasites affect their host as follows:

1. By damaging or consuming the host's tissues and thus reducing their absorptive capability.
2. By absorbing the host's food.
3. By sucking the host's blood and tissue fluids for which there is an obvious cost of replacement.
4. By causing mechanical obstruction of blood vessels, lymphatic vessels, or other vital channels, such as the bile duct or even the alimentary canal.
5. By causing wounds through which other kinds of pathogenic organisms may enter.
6. By secreting or excreting into the host various harmful substances such as hemolytic and digestive enzymes, possibly anti-enzymes and anti-coagulants.
7. By introducing into the host other species of parasites.

Worms in Your Herd. Illinois cattlemen have known for many years that cattle originating in the southeastern sections of the country may be heavily parasitized and that worming is indicated. But how about calves produced on Illinois farms, do they need worming?

Surveys of calves consigned to feeder calf sales in southern, east central, and western Illinois have revealed that roundworms may be a problem and control measures are needed. The incidence of parasitism may vary from herd to herd. The most reliable gauge for determining the need for worming in your herd is periodic examination of the feces by a veterinarian.

Life cycle. Cattle become infested with parasites by the ingestion of larvae on the soil and grass. The larvae mature in the stomach and intestines of the infected animal and lay eggs which are deposited in the feces. The eggs and larvae may live for some time in the soil before being ingested or consumed by other cattle. The entire life cycle from egg to adult to egg takes from 15 to 22 days or more.

Mass egg producers. The buildup of parasite eggs in a herd can reach serious numbers in a short period of time. Adults of some types of roundworms can lay 10,000 eggs per day. Four animals on 10 acres, carrying a moderate parasite load, can deposit 30 eggs per 100 square yard each day.

Good pastures can help reduce heavy roundworm population. Only about 2 to 3 percent of the larvae are reported to climb on the grass. Of this small percent, over half travel only one inch up the plants, about one-fourth go two inches, while the maximum height is five inches. High humidity seems to induce the climbing trend of larvae. Research studies show that larvae are most active at 80° F. and during periods of high humidity. The

highest percent of larvae remains at the soil level. Therefore, cattle grazing on short pastures would be likely to consume more larvae. Overstocking and close grazing contribute to a more severe infestation.

Prevention and corrective control. Illinois cattlemen are advised to adopt the following preventive and corrective measures.

Preventive Measures

1. Feed a balanced ration to provide good nutrition (research data suggest that cattle cannot be wormed adequately by placing them on a high feeding level).
2. Segregate obviously parasitized animals from the herd.
3. Keep cattle, especially calves, off pastures where parasitized cattle have been confined.
4. Keep cattle in drylot during the pre- and post-worming period to prevent contamination of pastures.
5. Raise feed bunks and watering tanks off the ground to prevent contamination with manure.
6. Frequently remove all bedding and manure from contaminated lots and sheds, and spread on fields not used by cattle.
7. Scatter manure or dung piles with harrow (as practiced by horsemen in contaminated pastures to expose larvae to sunlight).
8. Have your veterinarian check fecal samples, preferably from younger cattle, from 5 animals or 10 percent of the herd, whichever is greater, to determine the level of parasite infection in the herd.

Corrective Measures

1. If fecal examination indicates a heavy parasite load, worm the herd with one of the recommended anthelmintic drugs. In the case of purchased feeder calves or cows originating from the "parasite belt" the examination of fecal samples may be omitted and the animals wormed.
2. Worm cattle three or four days before turning them onto pasture in the late spring. This method will minimize infection of the pastures.
3. Worm at the approach of winter when the ground becomes frozen (about December 1 in Northern Illinois and December 15 in Southern Illinois). Combine treatment with movement to a non-pasture area when possible.

Anthelmintics. Several anthelmintics are available to the cattleman. These include phenothiazine, thiabendazole, Haloxon drench, and l-tetramisole. Most of these are available as boluses, drenches, and feed formulations.

Choice of anthelmintics and a regular worming program should be planned in cooperation with your veterinarian. Your program will vary with your location and type of management practiced.

External Parasite Control

Livestock producers must follow a sound program of insect control if they are to attain maximum income for their farming investment. Flies, lice, mites, ticks, and grubs irritate animals and some of them suck their blood. This reduces meat production. Several of these insects can transmit disease such as anaplasmosis and pinkeye from animal to animal. Thus, losses from these insects each year cost Illinois farmers millions of dollars. A beef producer does not need to share his profits with these insects. They can be readily controlled and in many cases eradicated.

Illinois Extension Circular 898, "Insect Control for Livestock and Livestock Barns," discusses the use of insecticides to control external parasites of livestock. Circular 925, "Insect Pests of Cattle," describes the life history, biology, and habits of insects that affect cattle. Both of these circulars may be obtained by writing to the Office of Agricultural Publications, College of Agriculture, University of Illinois at Urbana-Champaign, 123 Mumford Hall, Urbana, Illinois 61801. They may also be obtained from offices of county Extension advisers.

Hay and Pasture

Forage hay and pasture are the cornerstones of the feed program for cow-calf operations. Hay may be a supplemental feed to carry the herd through times of low feed supply (Fig. 15). Some reserve hay or silage should be in your plans. Such reserves allow the herd size to match total feed supplies rather than to match the periods of lowest feed production.

The forage needs for a cow and calf (spring drop and fall weaning) are approximately 20 pounds of hay per day during the wintering months and 30 pounds of hay per day during the pasturing months. The hay-equivalent[1] needs are approximately 3,000 pounds for five wintering months and 6,300 pounds for seven pasturing months, or a total of 9,300 pounds for a year. Average grazing management of pastures results in approximately 50 percent utilization. Therefore, pastures must produce over 12,000 pounds of hay-equivalent feed to carry one cow and calf through the pasturing season. Improving pasture management by rotation grazing and by harvesting excess seasonal pasture growth for feeding during periods of slow growth can reduce pasture losses, thus improving utilization. Obtaining high production from pastures and hay fields reduces the acreage per cow requirement. Regions where four to five tons per acre of hay equivalent can be produced by pastures may need 1.5 acres of pasture per cow-calf unit at 50 percent pasture utilization rate, but if the hay-equivalent production is near seven tons per acre, only 0.9 acres of pasture would be needed (Table 17).

High-yielding hay fields and pastures require good stands of high yielding species, high fertility, adequate moisture, and proper management.

Table 17. — Pasture Season Requirement for One Cow and Calf Unit (Spring Calving, Fall Weaning)

Pasture utilization, percent	Pasture management rating	Hay equivalents, pounds	Acres needed per cow-calf unit at:	
			4 T./A. hay equiv.	7 T./A. hay equiv.
50.....	Average	12,600	1.58	.90
60.....	Good	10,500	1.31	.75
70.....	Good	9,000	1.12	.64
80.....	Excellent	7,875	.98	.56
90.....	Superior	7,000	.88	.50
100.....		6,300	.79	.45

Selection of Species

Intended use, soil, and yield expectancy should be considered when selecting the legume or grass, or both, for pasture or hay production. Most forage species are acceptable for either hay or pasture use, but a few are primarily restricted to either hay or pasture.

Alfalfa is one of the most productive forage plants. The management requirement of infrequent cutting or grazing makes the plant more desirable for hay use than pasture. But with a little extra care, alfalfa may be the cornerstone of a pasture program.

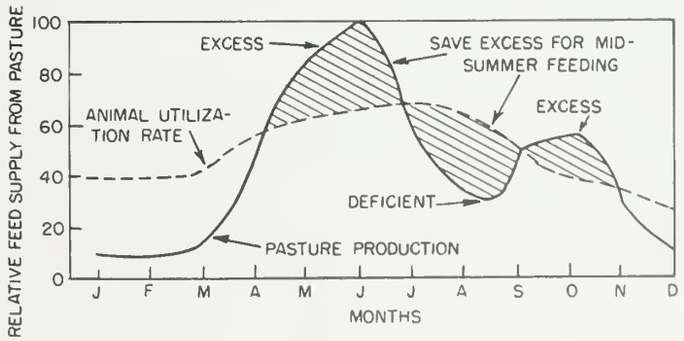
Alfalfa is highest yielding and longest lived on soils that have good internal drainage and some surface drainage, where the pH is 6.5 or slightly above, and where nutrients such as phosphorus, potassium, magnesium, boron, and so on, are in good supply. The importance of surface drainage increases as the effective internal drainage declines.

Highly productive varieties of alfalfa should be chosen for hay or pasture. For long-term stands, which may be desired for pasture especially, bacterial-wilt-resistant varieties should be chosen and they yield as much or more than susceptible varieties even during the first two years of production. Consult the county extension adviser for recent publications listing the performance of alfalfa varieties.

Birdsfoot trefoil is a non-bloating legume adapted to pasturing. It makes a fine quality hay, but is less productive than alfalfa. Birdsfoot trefoil suffers from a crown and root rot in the southern half of Illinois, and is not recommended in this region until a variety of proven resistance is found. Birdsfoot trefoil will withstand wetter soil conditions and lower pH than alfalfa. Because birdsfoot trefoil establishes slowly, timothy or bluegrass is suggested as a companion crop in mixture. Early spring seedings are most successful.

Crownvetch is a non-bloating legume of limited value as pasture or hay. The low productivity, slow recovery growth, and slow establishment of current varieties discourage wide use of crownvetch for pasture or hay. It does not thrive on wet or poorly drained soils, but will tolerate relatively low fertility.

Ladino clover is a shallow-rooted legume, very high in protein and digestibility. Because of the bloat hazard and short life of ladino, it is not usually suggested for beef pastures.



Approximate seasonal feed supply from pasture in Illinois. (Fig. 15)

[1] The term "hay-equivalent forage" is used when we want to relate the quantity of pasture to the quantity of hay. To do this, pasture yields are calculated on a 12-percent moisture basis.

Lespedeza, annual and perennial, may be used in southern Illinois. The perennial species, Sericea, has limited usefulness as a forage plant. Harvesting or grazing while the plant is young is necessary for good animal acceptance and utilization.

Annual lespedeza is productive in middle to late summer when most grasses are at their low ebb in production. It is much lower in productivity than alfalfa in regions where alfalfa grows well, but lespedeza is relatively more productive on soils with a pH of 5.6 or less and where available phosphorus and potassium are low, for instance during the early years of pasture improvement in the southern one-quarter of Illinois.

Red clover, a short-lived perennial, has nutritive qualities similar to alfalfa. Red clover is lower yielding than the newer alfalfa varieties on well-drained, productive soils. Red clover will tolerate wetter soils than alfalfa. Root and crown rots limit the productive life of red clover to two years.

Seeding and management of red clover are similar to alfalfa. Seeding year yields of red clover are much lower than alfalfa.

Kentucky bluegrass is relatively low in production, but well suited to permanent pastures. It is most productive during cool seasons. Continuous grazing may be practiced or spring growth may be stockpiled for summer use without a great loss in quality. Grazing should be controlled to retain at least 2 to 2½ inches of stubble.

Orchardgrass is well suited to the southern three-quarters of Illinois. It is marginally winter hardy for northern Illinois. Orchardgrass matures early in the season and produces throughout the summer where moisture is available. It is a very productive grass, but relatively early in maturity. Alfalfa is the best legume to seed in mixture with orchardgrass. Early maturing alfalfa varieties combine best with orchardgrass.

Red top is adapted to wet soils that have low productivity. It is low yielding and not suggested for use except in very extreme conditions of low fertility and wet soils.

Reed canarygrass is adapted to wet and dry soils. It is one of the most productive grasses under dry land conditions. Its growth is similar to smooth bromegrass, but reed canarygrass is more rank and becomes more fibrous at maturity. Reed canarygrass is productive in late spring, summer, and early fall. It turns brown at the first hard frost. Reed canarygrass has a great potential for pastures throughout Illinois.

Seeds with low germination and vigor have often been a problem in establishing reed canarygrass. Improvement through varieties, seed production methods, and seed handling has resulted in viable, vigorous seeds. Close scrutiny of the seed tag to determine the germination is a good practice. Seed reed canarygrass on good seedbeds. Haphazard seedings will usually be failures.

Management of reed canarygrass for hay requires early harvesting. Harvest before heading or just at heading. Harvest every 35 to 40 days after the previous harvest. Use rotational grazing. Graze 7 to 10 days and rest 25 to 30 days. If grown in mixture with alfalfa, follow the alfalfa management schedule.

Smooth bromegrass grows well throughout the northern half of Illinois on well-drained to moderately poorly drained soils. Smooth bromegrass matures a few days earlier than timothy, is more productive during the summer months, and makes good growth in the fall. Smooth bromegrass combines well with alfalfa for hay purposes. Its maturity and harvest management requirements are similar to alfalfa.

Establishment of smooth brome is more difficult than most other perennial forage grasses because of the light chaffy seed that is difficult to broadcast or to meter. Seeding with a grain drill or legume-grass seeder having separate grass seed boxes usually works well. Mixing legume seed and bromegrass seed usually results in separation of the seed, resulting in a non-uniform mixture. Mixing smooth bromegrass with oats works well if the seeding depth is no deeper than one-half inch.

Tall fescue is adapted to the southern half of Illinois. It has low value as a hay crop grass, but is an excellent spring, fall, and winter pasture. It has less animal acceptance and digestibility than the other grasses described here. It is relatively easy to establish either in spring or late summer. The seedling is vigorous and grows more rapidly than the other perennial grasses. It should be grazed after reaching 8 to 10 inches in height or cut for hay just as seed heads emerge. Alfalfa or red clover should be in the mixture if tall fescue is to be used for hay.

Tall fescue makes moderately little growth during dry summers and the animal acceptance of summer growth is poor. Consequently, growing animals make slow gains and mature animals may lose weight on tall fescue during July and August.

Tall fescue has been of exceptional value for beef enterprises when used for spring, fall, and winter grazing. Most successful winter grazing programs have involved harvesting one or two crops as round bales, usually left in place on the ground in the pasture. Partitioning winter pastures into units adequate to supply feed for 20 to 25 days has reduced wastage from round bales as compared with unrestricted grazing.

Timothy is best suited to the northern one-quarter of Illinois. Timothy is productive in spring, early summer, and fall. The low productivity during summer is largely caused by its sensitivity to heat. For hay or rotation pasture, timothy combines well with alfalfa, red clover, birdsfoot trefoil, and crownvetch. Timothy is one of the later maturing, tall, perennial, forage grasses. Timothy may be seeded in early fall or in the spring. Spring-seeded timothy produces a small crop in the seeding year.

Mixtures should be selected to serve a specific purpose. Simple mixtures of two or three species are usually preferred to complex mixtures of four to ten or more species. Simple mixtures are usually one or two legumes and one or two grasses. Each species should be selected for high yield, disease resistance, insect resistance, soil drainage adaptability, maturity, and winter hardiness.

Table 18. — Pasture or Hay Mixture Suggestions for Beef Enterprises[a]

Species and pounds of seed per acre

Northern Illinois

Alfalfa, 6 lb., and smooth bromegrass, 6 lb.
Alfalfa, 6 lb., and orchardgrass, 3 lb.
Alfalfa, 6 lb., and reed canarygrass, 6 lb.
Birdsfoot trefoil, 5 lb., and timothy, 2 lb.
Birdsfoot trefoil, 5 lb., and Kentucky bluegrass, 2 lb.
Birdsfoot trefoil, 5 lb., and orchardgrass, 3 lb.

Central Illinois

Alfalfa, 6 lb., and orchardgrass, 3 lb.
Alfalfa, 6 lb., and smooth bromegrass, 6 lb.
Alfalfa, 6 lb., and reed canarygrass, 6 lb.
Birdsfoot trefoil, 5 lb., and timothy, 2 lb.
Birdsfoot trefoil, 5 lb., and orchardgrass, 3 lb.

Southern Illinois

Alfalfa, 8 lb., and orchardgrass, 4 lb.
Alfalfa, 8 lb., and tall fescue, 6 lb.
Tall fescue, 10 lb.
Orchardgrass, 8 lb.

[a] For additional suggestions, see the current Agronomy Handbook.

Alfalfa combines well with timothy, smooth bromegrass, orchardgrass, and tall fescue. Red clover combines well with timothy, smooth bromegrass, and tall fescue. Birdsfoot trefoil and crownvetch combine well with timothy and Kentucky bluegrass.

Mixtures of one legume and one grass well suited to the soil and desired management will usually outyield mixtures of three or more species. See Table 18 for mixture suggestions.

Animal gains are usually greater on legume-grass mixtures than on straight grass (Table 19).

Annual grass pastures, hay crop, green feed, or silage including sudangrass, sorghum-sudangrass, grain and forage sorghums, corn, wheat, barley, and oats may provide emergency short-term feed or substantial amounts of stored feeds as in the case of sorghums and corn for silage.

Sudangrasses have finer stems and are more productive when grazed three or four times per season than sorghum-sudangrass hybrids. Sorghum-sudangrass hybrids are usually more productive than sudangrass or sudangrass hybrids when grazed or harvested one or two times during the season (Fig. 16).

Sudangrasses should be 18 inches tall before being grazed in order to assure high yields and low prussic acid potential. Sorghum-sudangrass hybrids should be 24 inches tall before grazing or harvest.

Small grains may occasionally provide either late fall or early spring pasture. If grain production is expected, grazing should be discontinued when the small grain embryonic seed head can be found in very young stem tissue near ground level.

Table 19. — Daily Gain by Steers on Pasture

Pasture	Pounds gained per day
Orchardgrass plus nitrogen	1.07
Orchardgrass plus clover	1.19
Tall fescue plus nitrogen	.89
Tall fescue plus clover	1.01

Sudangrass has more and smaller stems and more leaves than sorghum-sudangrass. The left half of this picture shows a fourth growth of sudangrass and the right half shows a fourth growth of sorghum-sudangrass on the right. These plants are about 20 inches tall. (Fig. 16)

Establishment

Fertilization, a weed-free and firm seedbed, even distribution of seed, firming the seed into contact with soil, weed and insect control during seedling growth, and conservative harvesting or grazing the first year are important management actions to help assure a productive stand of a forage crop.

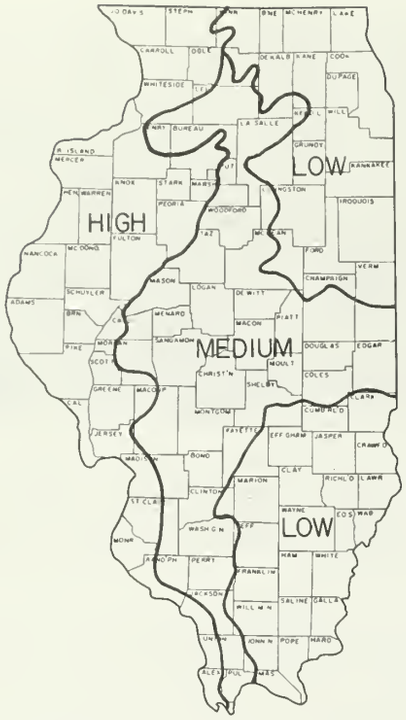
Lime should be applied to raise the pH to 6.5 to 7.0 if legumes are to be a major species in the pasture or hay field. If grasses are to be grown without legumes, a pH of 6.0 to 6.5 is adequate.

Limestone should be applied six months or more before seeding. However, seedings should not be delayed if lime has not been applied prior to seedbed preparation. Apply the lime during the early stages of seedbed preparation to obtain as much soil-lime mixing as possible.

Phosphorus is essential when establishing legumes and grasses. A soil test most accurately determines phosphorus needs. Phosphorus needs are determined from the soil test value and the phosphorus-supplying capacity of the soil. The soils of Illinois have been catalogued as *high, medium, or low* in phosphorus-supplying power. See Figure 17 and Table 20 for phosphorus fertilization suggestions.

Table 20. — Suggested Phosphorus Applications Before Seeding for High-Yield Goals

P_1 test			Pounds P_2O_5 per acre	
Phosphorus-supplying power of the soil			Broadcast seeding	Band seeding
Low	*Medium*	*High*		
25	15	10	180	90
30	20	15	150	80
38	30	20	90	60
45	40	30	60	40
60	50	40	..	30



Phosphorus-supplying power of Illinois soils. **(Fig. 17)**

Phosphorus may be broadcast and worked into the seedbed. Enough phosphorus for four years may be applied prior to seeding. If you band-seed, reserve at least 30 pounds of P_2O_5 per acre to be applied at seeding time with the band seeder.

Potassium is less critical than phosphorus at the time of establishment. Some additional potassium may be incorporated into the soil during seedbed preparation to improve the productive capacity of the stand. Rates of 300 pounds of K_2O or more should be plowed down to reduce seedling injury. Suggestions for potassium fertilization during seeding are based upon the soil-test value and yield expectancy (Table 21).

Previous crop. Alfalfa seedings should not follow a previous crop of alfalfa. Corn, soybeans, or small grain are desirable crops to precede hay and pasture seedings. Grass seedings are less sensitive to previous cropping history than the legumes.

Seedbed preparation. A weed-free, firm seedbed is desirable. Seedbeds for spring seedings do not have to be as firm as for late summer seedings. There is more moisture near the soil surface in a firm seedbed than in a loose seedbed. Depth of seeding is more easily controlled on firm than loose seedbeds.

Plowing may not be necessary if the previous crop residue does not interfere with preparing the seedbed and with obtaining good soil-seed contact at the time of seeding. Plowing will usually be needed where crop residues are so abundant that disking does not obtain nearly complete incorporation.

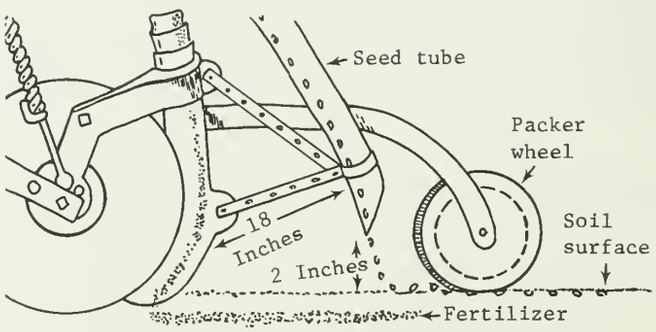
Table 21. — Suggested Rates for Potassium Applied Before Seeding Alfalfa and Alfalfa-Grass Mixtures Based on Expected Yield During the Seeding Year of a Spring-Seeded Crop or the Year Following Seeding of a Late-Summer-Seeded Crop

K test level	Expected yield of dry matter per acre	
	2-3 tons	3-5 + tons
	Pounds K_2O to apply per acre	
90 or less	160	220
91–120	120	180
121–150	80	140
151–180	0	60
181 and above	0	0

Small grain drill with band-seeding tubes, press wheels, and a grass-legume seed box. **(Fig. 18)**

Seeding method. Band seeding has resulted in higher yielding stands than broadcast seeding only on soils in which the available soil phosphorus is low. The fertilizer should be banded about 1½ inches deep in the soil and the seed placed directly above the fertilizer on the soil surface. The seed is where it can readily obtain nutrients shortly after germination. Well-nourished seedlings grow vigorously.

Band seeding can be done with a grain drill equipped with grass-legume boxes and flexible hoses leading from the grass-legume box openings to 15 to 18 inches behind each drill disk. The seed is dropped on the soil surface and a press wheel rolls directly over the seed, firming the seed in contact with the soil. Fertilizer is applied into the 1½-inch deep furrows made by the drill disks (Figs. 18 and 19).



Placement of high-phosphate fertilizer with grain drill. **(Fig. 19)**

Broadcast seedings are often higher yielding than band seedings on soils well supplied with phosphorus. The plants are more evenly distributed, reducing the competitive effects of closely placed plants. Equipment for broadcast seeding may be a grain drill or a seeder with two corrugated rollers that drop the seed of legumes and grasses between the two rollers.

Broadcast seeding essentials are:

1. Apply needed fertilizer to the seedbed and incorporate by disking.
2. Firm the seedbed *before* the seed is dropped onto the soil surface.
3. Firm the seedbed *after* the seed is dropped on the soil surface to obtain soil-seed contact and slight coverage.

Seeding depth. Forage legume and grass seeds are small and should be seeded no more than one-half inch deep. Most forage seeds should be seeded at one-eighth to one-quarter inch depth. Annual forages such as sorghums and sudangrass can be seeded 1 to 1½ inches deep.

Managing new seedings. Protect new seedings from excessive competition from weeds or a companion crop. Herbicides may assist in weed control. Consult the latest recommendations. Clipping when legumes and grasses begin to head out also helps control weeds. Close clipping will favor legumes. Companion crops should be harvested for green feed, hay, or silage at very early heading. If the companion crop is allowed to mature and the grain is combined, the stubble should be clipped and the straw removed.

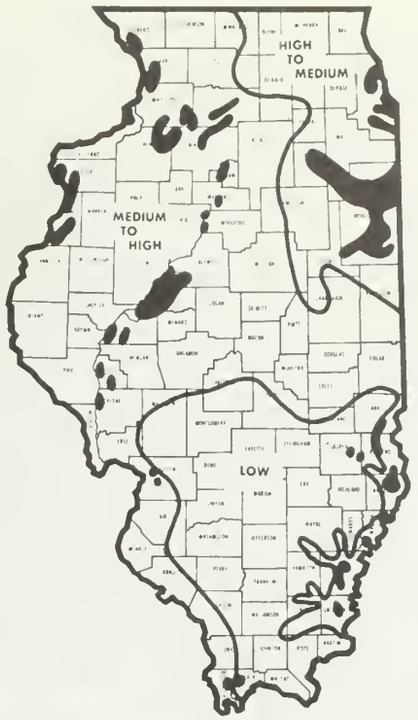
Fertilization of Established Hay and Pasture Fields

Nitrogen. Pasture or hay species, period of use, and yield goal are major criteria when considering nitrogen fertilization.

Kentucky bluegrass can profitably use 60 to 80 pounds of N per acre per year. Early spring application of nitrogen will be used most efficiently. September applications are less efficient but may be used to stimulate fall and early spring growth.

Orchardgrass, smooth bromegrass, tall fescue, and reed canarygrass can use 150 to 250 pounds of N per acre per year. Split applications of 75 to 125 pounds of nitrogen per acre lengthens the productive season of the grasses and provides a more uniform production from the high nitrogen rates. Make the first application in April if a high-yielding spring growth can be utilized. The second application is usually made after the first harvest or grazing cycle (about June 1). However, this application may be deferred until August to stimulate fall growth.

Legumes and legume-grass mixtures should not receive nitrogen if the legume makes up *30 percent or more of the mixture*. The main objective is to *maintain the legume*. After the legume has declined to less than 30 percent of the mixture, the objective is to *increase the yield of the grass*. Apply about 50 pounds of nitrogen per acre when the legume portion in a mixture is 20 to 30 percent, and apply 100 to 200 pounds of nitrogen per acre when legumes are less than 20 percent of the mixture.



Potassium-supplying power. The black areas are sands with low potassium-supplying power. (Fig. 20)

Phosphorus. This nutrient may be applied in large amounts adequate for more than one year. Annual fertilizer needs for hay and pasture crops are estimated by determining the nutrients removed by the crop and the capability of the soil to supply nutrients (Fig. 17). These crops contain about 11 pounds of phosphorus (P_2O_5) and 50 pounds of potassium (K_2O) per ton of dry matter. See Figure 17 and Table 22 for soil phosphorus-supplying power and suggested fertilization for three yield levels.

Potassium. Potassium is used in large amounts by high-yielding grasses. Soils low in available potassium (Fig. 20) will require additional potassium for top yields of grasses. Potassium improves the feeding value of grasses receiving large amounts of nitrogen by increasing the conversion of nitrogen to protein.

Table 22. — Suggested Annual Maintenance Fertilization for Alfalfa, Grasses, and Legume-Grass Mixtures

Nutrient-supplying power rating of the soil[a]	Yield expected or obtained (tons dry matter per acre)					
	5	7	10	5	7	10
	Phosphorus,[b] lb. P_2O_5 per acre			Potassium, lb. K_2O per acre		
Low	55	77	110	250	350	500
Low to medium	44	62	88	225	315	450
Medium	38	54	77	200	280	400
Medium to high	33	46	66	175	245	350
High to medium	28	38	55	150	210	300
High	28	38	55	125	175	250

[a] See Figures 2 and 4.
[b] Up to four years rate may be applied at one time.

Legumes use large amounts of potassium. Potassium is a key element in maintenance of legumes in grass-legume stands and is also credited with improving winter survival.

Potassium rates are determined from yield, nutrient content in the forage removed, and nutrient-supplying capacity of a particular soil. See Table 22 and Figure 20 for fertilization rates for different soil regions and three yield levels.

Potassium may be applied at any convenient time. Usually this will be in early spring or after the first harvest. Fall applications may be made on soils where there is no runoff of water during the fall and winter.

Boron. Boron deficiency symptoms appear on second and third cuttings of alfalfa during drouth periods in many areas of Illinois. But yield increases from boron fertilization have been infrequent. There is no recommendation for general application of boron in Illinois. If you suspect there is a boron deficiency, topdress strips in your alfalfa fields at the rate of 30 pounds per acre of household borax (3.3 pounds af actual boron). Use boron-fortified fertilizer for field applications. Apply boron at about three pounds per acre.

Sulfur. Sulfur is often suggested as limiting growth of forages in some areas of the midwest. We have no research to confirm the need for adding sulfur to forage crops in Illinois.

Pasture Production

Pasturing is a low-cost harvesting system, but the yield of nutrients per acre is less than mechanical harvesting of most forages. Tall grasses, such as timothy, orchardgrass, bromegrass, tall fescue, and reed canarygrass, as well as legumes such as alfalfa, red clover, crownvetch, and several birdsfoot trefoil varieties, yield more when grazed rotationally. A rest period helps these species maintain a vigorous plant. Alfalfa, red clover, and crownvetch should have a 30- to 35-day rest period between 7- to 10-day grazing periods or should be stocked lightly. The tall grasses should have rest periods similar to alfalfa, although they are slightly less sensitive to management than alfalfa.

Continuous grazing reduces yield only slightly or not at all for Kentucky bluegrass or Empire birdsfoot trefoil. Ladino and white clover produce well under continuous grazing, although the longevity of individual plants may be shortened by intensive continuous grazing.

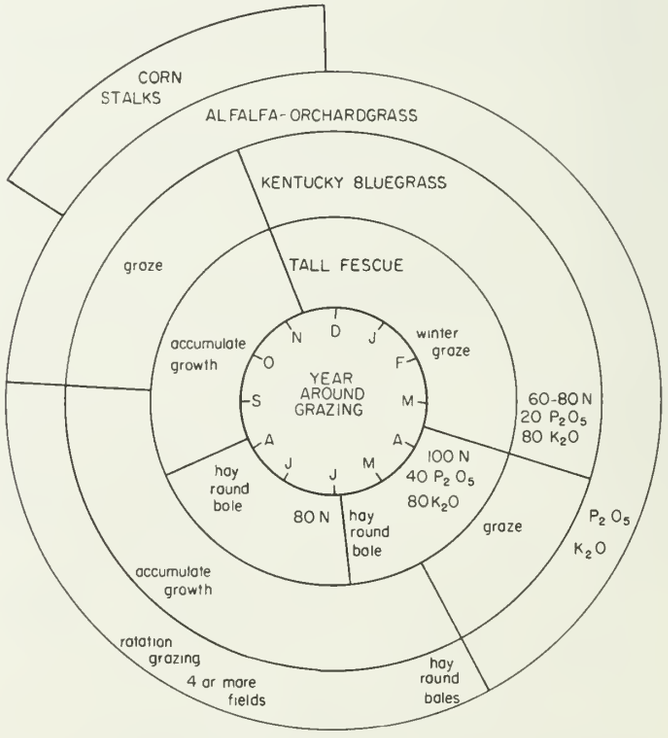
Pasture Systems

Systems of pasturing to provide feed the year around or to extend the grazing season well into winter have been devised.

Year-around grazing. The program centers around tall fescue used for late fall, winter, and early spring grazing (Fig. 21). Spring and summer growths of tall fescue are harvested as hay in round bales, and left in the field for supplementing winter grazing. Fall growth is accumulated. Kentucky bluegrass or orchardgrass is used for early spring pasture following the tall fescue winter pasture. Alfalfa-orchardgrass is the main forage supply for late spring through the summer. About half the alfalfa-orchardgrass first growth is harvested as hay in round bales, and left in the field to supplement mid-summer pasture. Some of these bales may be placed in storage for emergency winter feed. Rotational grazing is necessary for the summer grazing period. Cornstalk residues and Kentucky bluegrass provide fall grazing prior to the tall fescue winter pasture grazing period (Fig. 22).

Tall fescue pastures in Southern Illinois are part of a year-around pasture program. This is tall fescue in March after a winter grazing season. **(Fig. 21)**

Fertilization is an important ingredient in the production of these pastures. The bluegrass is fertilized in March with 60 to 80 pounds of N and whatever P and K are needed. Tall fescue is fertilized with 75 pounds of N and



A year-around grazing system. **(Fig. 22)**

whatever P and K are needed at the end of the winter grazing period. An additional 75 pounds of N is applied after the first cutting. The alfalfa-orchardgrass receives no nitrogen. Phosphorus and potassium rates are determined from the nutrient-supplying power of the soil and the yield obtained.

Deferred summer grazing. This plan uses heavily fertilized grasses, such as orchardgrass, bromegrass, tall fescue, or reed canarygrass for late fall grazing. The area is grazed in spring and early summer. It is heavily fertilized at the end of the early summer grazing period and summer growth is allowed to accumulate. Fertilize these all-grass pastures in late March or early April with 40 to 50 pounds of nitrogen and adequate rates of P_2O_5 and K_2O for the total season production of four to five tons of dry matter per acre. An additional 80 pounds nitrogen should be applied in early June and 120 pounds on August 1. The spring-summer grazing period extends from April to August 1. The fall grazing period is approximately October 15 to December 20. Beef production results obtained from this pasture system in Iowa are shown in Table 23.

Table 23. — Beef Gains on Deferred Summer Grazing Program

	Pounds beef produced per acre, 1967-1969		
	April-August	*October-December*	*Total*
Tall fescue	339	293	632
Reed canarygrass	346	199	545
Smooth bromegrass	408	198	606
Orchardgrass	369	203	572

Pasture Management

Legume-tall grass pastures must have rotational grazing for high productivity. The grazing period should be no greater than 7 to 10 days and the rest period between grazings should be no less than 28 to 30 days. A minimum of five pasture areas is needed. A heavy stocking rate to obtain rapid removal of the pasturage is desirable.

A three-inch stubble should remain at the end of the grazing cycle for the tall grasses and 2 to 2½ inches of stubble should remain from Kentucky bluegrass. The legumes may be grazed much closer. The energy reserves for grasses are in the lower stem and sheath material. Close grazing removes the energy reserves that are needed to stimulate new growth.

Legumes have a fleshy root which stores the reserve energy. The energy reserves of these plants are almost entirely below ground. There are some energy reserves in the crown area. New growth comes from crown buds which obtain their energy from sugars and starches stored in the root and crown. Close grazing can remove very little of the energy reserves of legumes, therefore close grazing is an acceptable practice during the growing season.

Winter Management

Grazing legumes and grasses may be done during the winter with little or no damage to the plants if certain precautions are observed. Grazing on wet soils results in extreme plant injury. Injured plants may die or are weakened when disease organisms enter and establish crown and root rots.

The height of stubble remaining after grazing is important for grasses. Energy reserves are necessary for winter survival and vigorous spring growth. Timothy stores the majority of its energy reserves in a bulb-like structure, haplocorm, which is below the soil surface and thus not subject to grazing. Removal of top growth during the winter has less detrimental effect on timothy than on the other hay-type grasses, however timothy should not be grazed abusively. If a few leaves are left ungrazed during the winter, the extremes in temperature variation of the plant will be modified. Therefore, timothy may be grazed shorter than the other tall grasses, but it is unwise to denude a timothy field by grazing. The other tall grasses should have at least a three-inch stubble throughout the winter.

Kentucky bluegrass withstands close cropping during winter, mainly because of its short and decumbent growth pattern. Kentucky bluegrass and timothy should not be grazed to less than a two-inch stubble in late fall or winter.

Alfalfa, red clover, ladino clover, birdsfoot trefoil, and crownvetch are similar in food storage and source of new spring growth. Large fleshy taproots or fleshy branching roots contain the food reserves for winter and for vigorous spring growth. Most of these legumes have crowns that are set very low, and thus are fairly inaccessible to grazing animals. Some varieties of alfalfa have fairly well-exposed crowns and may be harmed more by close grazing in winter or summer than the varieties with low-set crowns.

Close grazing of legumes is acceptable except when the hazards of ice sheet and heaving occur. These two major problems should modify grazing plans for legumes. Ice sheet damage occurs more often in northern Illinois than elsewhere in the state. Leaving a few tall stubbles of legumes or grasses reduces the chances of a complete seal from ice. Stems that manage to stick through the ice provide for some movement of air and may make the difference between survival and death of the plants. Heaving is more often a problem in southern Illinois, especially on poorly drained soils. Heaving damage can be reduced by improving soil drainage and by leaving a mulch of crop residues on the soil surface. The mulch reduces the temperature fluctuation near the soil surface. Alternate freezing and thawing by night and day create the heaving action. In locations potentially plagued with ice sheet or heaving problems, limit the grazing of legumes and grasses and allow three to six inches of stubble to remain for protection against these climatic hazards.

In Illinois beef cows are increasing fastest in areas where hay and pasture production can be enhanced. (Fig. 23)

ECONOMICS OF BEEF COW HERDS IN ILLINOIS

The decision on whether to include a beef cow herd in the farm business or expand the present beef herd requires information in several areas. These areas are defined by the following questions:

1. What has been the trend in beef cow numbers in Illinois?
2. What are the future prospects for the consumer demand for beef?
3. Where do beef cows fit into your farming operation?
4. Which beef cow herd production option should you choose — sell weaned calves, yearling feeders, or finished market animals?
5. What is the amount of labor required for various sizes of cow herds?
6. What tools can you use in analyzing the profit potential of a beef cow herd?

Trends in the Number of Beef Cows in Illinois

Beef cow numbers have more than doubled since 1950, with the January 1 inventory amounting to 802,000 in 1972. But since 1965 the number of beef cows has been at a plateau. During the same period (1950 to 1972) the number of dairy cows declined by 72.6 percent (Table 24). In many cases the increase in beef cow numbers resulted from a shift in resources from dairy to beef production. This type of shift was more apparent in the livestock and crop-livestock areas where non-tillable pastures involved in dairy production could be used for beef herds.

Beef cows are found throughout Illinois, with heaviest concentrations in the western portion of the state. The livestock area remained the most important beef cow area with a 97.3 percent increase in beef cow numbers between 1950 and 1970. The crop-livestock area had a

Table 24. — January 1 Inventories of Beef and Dairy Cows — Two Years Old and Over, by Farming Areas, Illinois[a]

	Beef cows				Dairy cows			
	Cash-grain area	Live-stock area	Crop-livestock area	Total	Cash-grain area	Live-stock area	Crop-livestock area	Total
	Thousands of cattle							
1950	91.2	205.6	83.2	380.0	166.4	593.7	240.9	1,001.0
1955	161.5	333.3	146.2	641.0	129.5	548.0	197.5	875.0
1960	146.3	338.7	183.0	668.0	84.9	431.6	131.5	648.0
1965	153.6	413.1	229.3	796.0	54.4	336.6	99.0	490.0
1970	114.3	405.5	208.2	728.0	27.4	209.4	71.2	308.0
1971	116.2	422.2	211.6	750.0	24.9	197.5	70.6	293.0
1972	121.1	454.7	226.2	802.0	23.5	192.2	70.3	286.0
Percentage changes, 1950 to 1972	32.8	121.1	171.8	111.1	−86.0	−67.7	−70.9	−71.4

[a] These are three types of farming areas which can be defined by major enterprises or enterprise combination.
Sources: 1950-1965 — The Illinois Beef Industry Characteristics, Trends, and Inventories, AERR-101. N. R. Martin, D. C. Petritz, and R. N. Van Arsdall. Department of Agricultural Economics, University of Illinois. October, 1969. 1970 — Annual Summary, Illinois Agricultural Statistics, 1971-72 Illinois Cooperative Crop Reporting Service and unpublished data.

150.2 percent increase while the cash-grain area had a 25.2 percent increase.

The soils in the cash-grain area are characterized by a high proportion of level productive soils that are suited to intensive row-crop production. The areas of large increases in beef cow numbers have a higher percentage of soils suited for rotational or permanent pasture or hay production (Fig. 23).

Future Prospects for Consumer Demand for Beef

Beef is a food with high consumer preference. Per capita beef consumption has increased from 50 pounds in 1940 to an estimated 116 pounds in 1972. Rising income levels plus growth in the population have contributed to an increase in domestic beef production from 10.6 billion pounds in 1948 to 1950 to an estimated 22.5 billion pounds in 1972.[1]

It is estimated that the U.S. population in 1980 will be about 235 million and per capita beef and veal consumption will be about 130 pounds. If that many people eat this much beef and veal, the annual domestic beef and veal production will have to be increased to 29.2 billion pounds.[2]

Based on these estimates, the national beef cow herd will have to be increased substantially. It is estimated that about 44 to 46 million beef cows will be needed by 1980.[2] This is an increase of nearly 30 percent over the 1969 inventory of 36 million beef cows. It is difficult to say where these additional beef cows will be located within the United States. However, those regions with large quantities of available forages and roughages should be highly competitive in the national beef industry.

Beef Cows in the Farm Business

Beef cows can add to farm income if they are placed on a farm where they are suited. The farm operator should determine under what circumstances beef cows will provide a higher level of returns than alternative crop or livestock enterprises.

Depending on the resources available on their farms, farmers do not figure costs the same way. Examples of different methods of determining costs are presented in Table 25 for three farmers with beef cow herds.

Mr. Brown figures only the direct or out-of-pocket expenses associated with his beef cow herd. These costs vary with the volume of business. They include market value of grain fed, purchase costs of equipment, harvesting charges for forages, veterinary and other livestock expenses, and fuel and repair expenses on power, machinery, and equipment. He does not charge for pasture, hay, buildings, and labor because these resources would not be used if it were not for the beef cow herd. His income exceeds the costs he has charged to the beef herd by $95 per cow.

Mr. Green also charges direct or out-of-pocket costs against his cow herd. However, he charges for the use of several resources that Mr. Brown did not. Mr. Green charges $10 per ton of hay equivalent for all hay and pasture used. He reasons that if he did not feed the hay and pasture to his cows, he could sell it or feed it to other livestock. Mr. Green also charges depreciation and fixed costs on his machinery, plus 7 percent interest on his investment in livestock and feed. He does not figure building or labor costs, because the buildings are already there and he can utilize excess labor to handle the cattle. Mr. Green's income exceeds the costs he charges against the cow herd by $41 per cow.

Mr. White maintains that his cow herd should pay all costs including building costs, labor costs, and a share of the general farm expense. Using Mr. White's assumptions, returns from the beef cow herd were $3 per cow. This represents the situation where a beef cow herd would be started from scratch. That is, buildings must be built, capital invested in purchasing cattle, pasture and hay diverted from other uses or purchased, labor hired or diverted from other productive jobs. In Mr. White's case, all costs must be covered in order for the beef cow herd to be a profitable addition to the farm business.

Once a farm operator has determined what his resource situation is, and what the expected gross returns and costs are for the beef cow herd, he can make a decision concerning the profitability of beef cows. He can determine whether or not the expected gross returns will cover direct costs only, direct costs and a portion of the fixed costs, or all costs associated with the cow herd. In any one year, direct out-of-pocket costs must be covered by returns if the producer is to continue to operate the enterprise. Over a period of years, fixed as well as direct

Table 25. — Estimated Returns and Costs per Cow From Cow-Calf Enterprise when Costs Are Figured in Three Different Manners (Assuming a 30-Cow Herd and Calves Sold at Weaning)

Item	Mr. Brown[a]	Mr. Green[b]	Mr. White[c]
Gross return to enterprise	$129	$129	$129
Direct cost items			
Grain, protein, mineral	11	11	11
Hay, pasture, straw harvest costs	11	11	11
Net depreciation on bull and veterinary expense	6	6	6
Other cash expense	1	1	1
Power, fuel, and equipment repair	5	5	5
Other possible cost items			
Interest on cattle investment		20	20
Building costs			8
Labor at $2 per hour			30
Hay, pasture, and non-salable pasture-market value		34	34
Total costs	34	88	126
Income over costs	95	41	3

[a] Mr. Brown considers no alternative use of capital, labor, and pasture land.
[b] Mr. Green considers alternative uses of capital and pasture land.
[c] Mr. White considers alternative uses for all resources.

[1] 1972 Handbook of Agricultural Charts, Agricultural Handbook Number 439, USDA.

[2] Thomas T. Stout. The U.S. Beef Industry in 1980. Paper presented at the Fifteenth Annual Beef Industry Workshop of the Canadian Agricultural Economics Society, Banff, Alberta, Canada, June 7-12, 1970.

Calves can be grown on pasture or other roughage to provide another production option. They could then be sold as yearling feeders or retained on the farm for finishing. (Fig. 24)

costs must be covered by returns if the beef cow herd is to continue to be operated on a profitable basis, especially where fixed items wear out and must be replaced.

In general, beef cows may add to the farm income under the following conditions:

1. When cows can be used to consume permanent pasture or other forms of roughage that might go unused. Corn stalks and field corn left in the field can be utilized by herds of beef cows. Nontillable pastures or woodland pastures also fall into this category.

2. When fences, buildings, and other equipment are already available on the farm. Use of existing facilities reduces the initial investment needed to get a beef cow enterprise started.

3. When excess labor is available on the farm. The beef cow herd can use labor that normally would not be used, and it also combines well with off-farm job opportunities.

4. When capital is available for starting the herd, and if there is no immediate demand for cash income. The turnover of capital invested in beef cows is very slow, and this must be considered by the farm operator.

5. When level of management is high. High-level management is needed if the beef cow herd is to fit into a growing farm business. Studies have indicated that improved performance through a high-percentage calf crop and high weaning weights are a necessity for profit in a beef cow enterprise (Fig. 24).

Beef Cow Herd Production Options

Using long-term average prices and costs, a farm operator can budget the returns that can be expected from a beef cow enterprise. By this method, the farm operator can compare the expected return on his beef cow investment with other alternative investments. In addition, the farm operator can determine which beef cow production option is best suited for his farm and the available resources found on it. He may sell the calf at weaning time when it weighs about 400 pounds, or he may keep the calf and grow it out on pasture or other roughages and sell it when it weighs from 700 to 800 pounds. Finally, he can keep the calf, feed it out, and sell it as a fed market animal.

Estimates of the returns and costs of production for each of these three options can be found in Table 26. The level of costs and returns in Table 26 are based on expected long-term average prices and production performance rates of an enterprise already in production. Individual farm operators may want to adjust these prices or production rates based on the existing situation in their locale. Several factors affect the level of gross returns. These include: calving percentage, weaning weights, quality of calves produced, estimated prices for calves, rate of cow replacement, and prices of replacement cows.

In analyzing the costs and returns of the three alternative options in Table 26, the alternative where the calf is fed out returned the largest income above direct costs.

Table 26. — Budget Procedure for Determining Livestock Income Over Direct Costs: Beef Cow Herd[a]

	Beef cow, calf sold		Beef cow, calf grown-out		Beef cow, calf fed-out	
SECTION A						
Source of income	92 percent calf crop 5 percent death loss 16 percent saved for replacement .44 steer calf × 425 lb. @36¢ .27 heifer calf × 400 lb. @33¢ .15 cull cow × 1,000 lb. @20¢	 $67 $36 $30	92 percent calf crop 6 percent death loss 16 percent saved for replacement .435 stocker steer × 725 lb. @30.5¢ .265 stocker heifer × 650 lb. @28¢ .15 cull cow × 1,000 lb. @20¢	 $96.00 $48.00 $30.00	92 percent calf crop 7 percent death loss 16 percent saved for replacement .43 steer × 950 lb.[c] @30¢ .26 heifer × 850 lb. @28¢ .15 cull cow × 1,000 lb. @20¢	 $122 $62 $30
Less marketing costs		−$4		−$4.50		−$5
Gross income to farm per enterprise unit		$129		$169.50		$209
SECTION B						
Variable direct-cost items						
Corn equivalent	6 bu. @ $1.15	$7	18 bu. @ $1.15	$21	40 bu. @ $1.15	$46
Protein, mineral, salt	70 lb. @ 5¢	4	154 lb. @ 5¢	8	240 lb. @ 5¢	12
Hay, straw harvest cost	1.8 tons @ $6	11	2.2 tons @ $6	13	2.4 tons @ $6	14
Net depreciation on bull		4		4		4
Veterinary and medical		2		3		3
Other cash livestock expense		1		1		1
Power, fuel, and equipment repair		5		6		7
Total direct costs		34		56		87
Income over direct costs		95		113.50		122
SECTION C						
Other possible cost items						
Depreciation, repairs, and taxes on buildings	$60 × 10 percent	$6	$80 × 10 percent	$8	$100 × 10 percent	$10
Interest on all capital	$320 × 7 percent	22	$425 × 7 percent	30	$467 × 7 percent	33
Labor[b]	15 hrs. @ $2	30	20 hrs. @ $2	40	25 hrs. @ $2	50
Hay and pasture	3.4 tons @ $10	34	3.9 tons @ $10	39	4.1 tons @ $10	41
Nonsalable pasture	1.6 tons @ $0	..	1.7 tons @ $0	..	1.7 tons @ $0	..
Overhead		10		12		15
Income over all relevant costs, **My Farm**		..		..		..

[a] The Costs and Income values for Calf Sold and Calf Fed-Out Programs are from Table 6b of the Farm Management Manual, AE-4281, Department of Agricultural Economics, University of Illinois, January, 1972. The Costs and Income values for Calf Grown-Out were developed from other budgets that appeared in that publication and with the assistance of R. A. Hinton.

[b] Includes labor required to harvest hay and straw and to haul manure. These labor requirements are based on the labor requirements for a 15- to 39-cow beef herd.

[c] The 950-pound weight is below suggested market weights of 1,000 to 1,100 pounds, but reflects average sale weights in recent Farm Business Farm Management annual summaries.

This alternative returned $27 more per cow than the calf-sold option. The calves-fed-out alternative is estimated to have $8.50 more return over direct cost than when calves were grown out to 725 pounds and sold. The difference in the level of returns above direct costs reflects the added costs involved in buildings, fences, feeding equipment, labor, and other overhead expenses that are required for the grow-out or feed-out options.

A farm operator should carefully weigh the advantages and disadvantages of each of the three options, depending on his own situation. He must consider the resources that he has available such as a non-salable pasture, crop roughages, buildings and equipment, labor, and feed grains. Depending on the availability of these resources, he must decide whether to have a larger beef cow herd and sell the calves at weaning or to grow-out or feed-out the calves and have a smaller cow herd.

The return over direct costs per cow is not the only criterion to use in choosing the beef-cow option. In addition, the farm operator should consider the size of each enterprise that his available resources would support. For instance, if only 600 hours are available, he could keep 40 cows under option I, 30 cows under option II, and 24 cows under option III. The largest net return is $3,800 for 40 cows and selling the calves.

Labor Requirements for Various Sizes of Cow Herds

The labor value of 15 hours per cow presented in Table 26 for the calf-sold option is based on a herd size of 28 cows. Many beef cow herds in Illinois are larger than this. Studies involving 132 beef cow herds in Missouri reported an "economy of size" effect regarding the hours of labor used.[1] Economies of size simply means that an increase in the size of the herd often results in more efficient use of resources. For example, some jobs such as

[1] H. Lanpher and A. R. Hagan. Labor Requirements for Beef Cows, Bul. 838. University of Missouri Agricultural Experiment Station. 1965.

Table 27. — Hours of Labor Required per Cow per Year by Various Sizes of Herds, Missouri[a]

Herd size	Labor requirements per cow[b]	Total herd requirement
	Hours	
10	8.00	80
25	6.50	162
50	5.40	270
75	4.80	360
100	4.50	450
120	4.25	510

[a] Labor requirements do not include time for harvest of hay and straw, but the values in Table 26 did.
[b] Labor requirement for beef cow operator where calf is sold at weaning.
Source: H. Lanpher and A. R. Hagan, Labor Requirements for Beef Cow, Bul. 838. University of Missouri Agricultural Experiment Station. December, 1965.

Table 28. — Hours of Labor Required per Cow per Year by Job and by Various Sizes of Herds, Minnesota[a]

	Number of cows in herd 15–40	41–70	70
	Hours		
Feed handling[b]	8.6	5.7	3.9
Cleaning and bedding	1.5	.8	.6
Calving	2.0	1.7	1.4
Other — fencing, checking, dehorning, and castrating	4.3	2.6	1.9
Total hours	16.4	10.8	7.8

[a] Labor requirements are averages for beef cow operations where calves are sold at weaning, grown out, or fed out.
[b] Labor requirements do not include time for harvest of hay and straw, but the values in Table 26 did.
Source: A. R. Wells, S. A. Engene, and T. R. Nodland. Economics of Beef Cow Herds in Northeastern Minnesota, ESRS 684. Department of Agricultural Economics, University of Minnesota. 1968.

climbing up into the hayloft or hitching up the feed wagon take the same amount of time, no matter what the size of the herd. Thus, as the herd gets larger, the amount of labor required per cow to perform these jobs is reduced. The relation between the amount of labor required and herd size is indicated in Table 27. These values show the result when herd size and total hours are considered, with no allowance for variation in other factors, such as kinds of roughage fed or management practices used. It should be pointed out that the Missouri labor figures do not include the labor required to harvest hay or straw for the beef cow enterprises while the Illinois values did. This difference is about five to six hours of labor per cow.

Note that there was a sharp drop in the amount of labor required per cow up to 50 cows. From 50 up to 120 cows, the rate of decline in labor requirements was much slower. Results of a study conducted by the University of Minnesota also indicated a reduction in labor used per cow as the size of the herd increased.[1] Their labor figures are larger than Missouri's labor requirements for two reasons. First, the Missouri labor requirements are for care of the cow and calf up until the calf is weaned. Minnesota's labor estimates are averages for all three beef cow options — sell as a weaned calf, grow out, and feed out. Secondly, more severe weather conditions in Minnesota require larger amounts of time for jobs such as checking and observing, bedding, and manure removal and feeding (Table 28).

Although labor requirements can be reduced under certain management systems, the farm operator must be cautious in reducing the labor requirement drastically. If essential management practices are omitted or hurried through, the performance and resulting profits of the beef herd may be reduced. The results of the Missouri and Minnesota studies indicated that more than one-half of the total time required in beef cow herds was in feeding and watering. The next largest time-consuming job was observing and checking cattle. If any attempts are made to reduce labor requirements, it should be in these areas. The farm operator should analyze his labor practices and methods, and determine if he can increase his labor efficiency in these repetitive jobs without reducing the performance of his cow herd.

[1] A. R. Wells, S. A. Eugene, T. R. Nodland. Economics of Beef Cow Herds in Northeastern Minnesota, ESRS 684. Department of Agricultural Economics, University of Minnesota. November, 1968.

Tools To Analyze the Profit Potential of Beef Cow Herds

Records. Every farmer who plans to continue farming on a profitable basis should keep records. The farm operator should keep farm business records which include income, expenses, inventories, and depreciation schedules. The farm operator with a beef cow herd should also keep performance-testing records. These are discussed in another section of this publication (Fig. 25).

Complete farm records will help the farm operator understand his strengths and weaknesses. They provide a method for the operator to analyze his performance. He can compare his income and efficiency measures with the performance of other farmers who are in the same size class.

Budgets. Budgeting is simply planning the future use of a farm operator's time and money. There are several

Records provide the basis for evaluation of the farm business and for planning for the future. Producers need to maintain both production and business records on their herd. (Fig. 25)

types of budgets that a farm operator can use in analyzing changes in the farm business. One is a *complete farm budget* which includes the entire farm business income and expense items. This type of budget would be used in analyzing the effects of reorganizing the entire farm business.

A second type of budget is the *partial budget* which includes the effect on expenses and income that will occur if a change is made in a farm enterprise. It is a short-cut method that can be used to answer the following questions:

1. Is this change profitable?
2. Is this the cheapest and most efficient way?
3. Could I use this capital elsewhere in my business and get a higher return?

A third type of budget is the *cash-flow budget*. Unlike the complete and partial budgets which provide either an estimated average annual net income figure or the size of the change in this net income, the cash-flow budget provides a tool for management of the farm's financial situation. It provides the farm operator with a method for planning and coordinating the financial affairs of the farm and home business. An annual cash-flow budget can be used to estimate the time of receipts and expenses of the farm and home business during the calendar year. The monthly flow of receipts and expenses will help the farm operator determine his credit needs and the time for repayment of his debt.

More important for the farm operator who is considering starting or expanding a beef cow herd is the *long-term cash-flow budget*. This cash-flow budget provides the decision-maker with the opportunity to analyze and plan the receipts, expenses, major investments, and debt repayment over a five- or ten-year period. Although a complete or partial budget may indicate that the beef herd will be profitable in an average year, it is the long-term cash-flow that will determine whether a beef herd is an economically and financially feasible addition to the farm business. The per cow investment in starting a beef cow herd is relatively large. Using a cash-flow budget, the farm operator can determine if he can continue to pay his cash expenses and meet family living expenses, as well as repay his borrowed capital, with the receipts from his cow herd. The success or failure of the beef cow herd is determined many times by whether the rest of the farm business can support the beef herd during the first few years of its development. Even the farm operator with sufficient capital should use budgets to more adequately analyze and plan the addition of a beef cow herd to the farm business.

Terms of financing beef cow herd operations vary with the financial institutions and individual financial position. Repayment periods for beef cow herd expansion will vary from three to seven years for most financial institutions in Illinois. Longer term financing will be required if the beef cow herd is started with heifer calves in comparison with mature cows.

For more information and assistance in developing budgets for analyzing the farm business, consult Illinois Extension Circular 1042, Mechanics of Farm Financial Planning, available at the Extension adviser's office in your county.

Distribution of beef cows in Illinois, January 1, 1970, inventory (Source: Annual Summary, Illinois Agricultural Statistics, 1970, Illinois Cooperative Crop Reporting Service). (Fig. 26)